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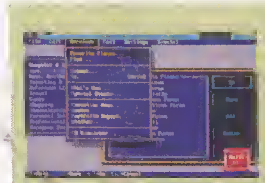

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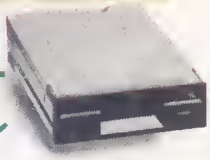

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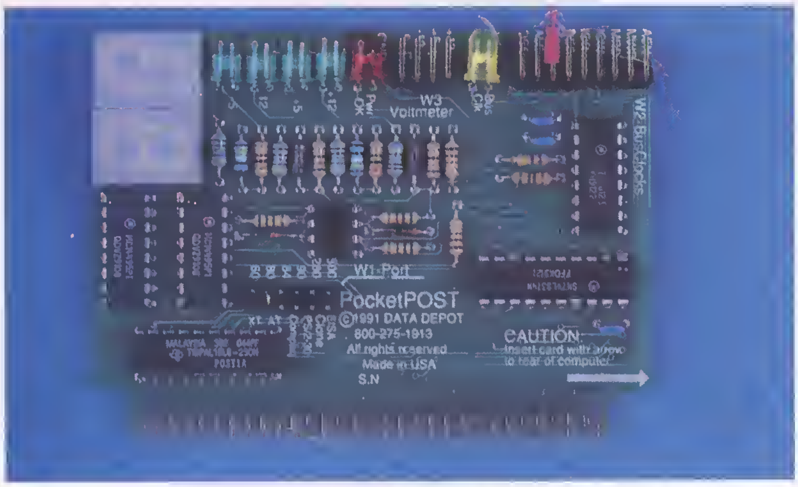

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Cover Design by Emerson, Wajdowicz Studios, New York City

FROM THE EDITOR

There is no doubt that we are in the midst of a recession. Most of us are now practicing the frugal habits that we always heard our parents and grandparents talk about. In fact, many sociologists and economists are saying that this recession will have lasting effects on the American psyche, i.e,, we will never return to our spendthrift ways.

Thus, whether you're a corporate computer manager or you run your own mail order business from the kitchen table, PC Upgrade has you in mind. In this and every issue we feature articles that will save you and your company money.

But that's not all PC Upgrade is about. Each issue also offers, without frills, the straight stuff to make the time spent at your computer more productive.

In this issue, we've devoted over a dozen pages to a special DOS 5.0 section in which we review DOS basics such as creating directories and subdirectories as well as taking a look at the new DOS 5.0 directory commands, plus DOSKEY and the new HELP functions.

Two must-read articles for businesses that look to run lean without sacrificing productivity are our step-by-step guide to do-it-yourself tape backup installation plus a feature on POST (Power On Self Test) cards to diagnose downed PCs before the serviceman is called.

We also take a close look at tape drives from Maynard Electronics and Irwin Magnetics, and review a new portable hard disk from Quantum. In addition, we offer you our Hard Disk Dictionary so that you can understand the unavoidably technical language of our hard disk comparison charts.

For those of you who suddenly find themselves on the outside looking in at Windows, we offer a legitimate upgrade path so that your non-Windows system can operate like a Windows system without reinvesting in new equipment.

If you have one of the original IBM PCs, XTs or their clone equivalent, our feature on "Rebuilding Without a Hitch" tells you how to give a PC the power of an AT system by installing high-density drives, a new VGA monitor and a bigger power supply.

We honestly don't think you'll find any other magazine packed with the equivalent number of how-to articles to help you improve your computer's capabilities.

We're more than just a how-to magazine however. You'll find the lead story on "Sourcing Computer Equipment" an informative piece of journalism.

The editors look forward to your comments, questions and suggestions. If you have a problem write to our Hardware Doctor for an answer. In next issue we will introduce the Software Doctor. The editors urge you to write the Frugal Techie if you've found an interesting way to save money without giving up productivity. Any reader whose suggestion is published will receive a free subscription.

Ephraim Schwartz

EPHRAIM SCHWARTZ
EDITOR-IN-CHIEF

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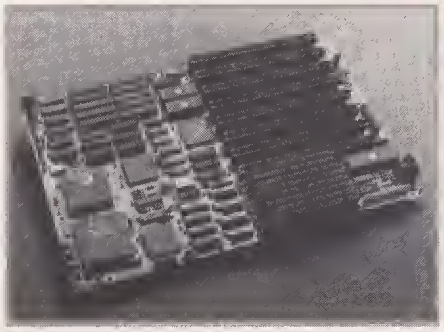

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vicing. It's possible that the power supply in your computer only had a blown fuse, but you were charged for a complete replacement. You'll never know for sure now, but if it ever happens again, you know what to ask.

If you feel comfortable fixing your own computer, you may be able to service or replace the power supply yourself. If the power supply in your computer appears defective, first check to see that it's not a bad power cord. Obvious, perhaps, but you'd be surprised how often people neglect this simple solution. And while we're on the subject of obvious solutions, you'll also want to be sure that the power cord is securely inserted into the wall, and in the power supply socket at the rear of your computer.

To replace the power supply, turn the computer off, and unplug it. Open the computer's case and locate the power supply box. Disconnect the colored power leads from their respective components, noting where everything goes. With most power supplies, the wires leading to the motherboard are grouped into two harnesses, often labeled P8 and P9. Note the color coding. (Write it down for safe keeping!) When you replace the power supply, you'll want to line up the harnesses the same way, and follow the same color sequence. Failing to do this could result in damage to the new power supply and your computer's motherboard.

The power connectors for the disk drives are polarized, and can only be re-installed one way.

The power supply is attached to the computer's case by four screws. These screws are located either at the back or bottom of the computer case. Carefully loosen the screws and save them for later. The power supply should come right out.

Install the new power supply in the reverse order.

If you have experience servicing electrical appliances, you might try your luck at fixing a balky power supply. While a label on most power supplies reads "No user-serviceable parts inside," this isn't entirely true. For example, there's the fuse we told you about earlier. This fuse may be installed in a fuse holder, or it may be permanently soldered in place. Be sure to replace the fuse with an exact match; that is, if the fuse is ratedfor 10 amps at 125 volts, don't install one rated for 20 amps at 125 volts.

In addition to the fuse, another possible culprit is the main switch. If the switch is bad, the power supply will never get any juice from the wall socket. Replace the switch and you'll be in business. You may find, however, that exact replacements for power supply switches can be hard to find. You may have to snoop around a surplus shop, or cannibalize another bad power supply.

If you find that you can't service a faulty power supply, don't bother taking it in for repair. The labor costs will probably far exceed the price of a new replacement. Depending on where you purchase the power supply, and the wattage of the unit, you'll pay from $35 to $75 for a brand new one. Most repair shops charge that much just to give you an estimate.

Note that there are several styles of power supplies for "generic" PC clones. They are designed to fit certain types of computer cases. At the bottom rung are replacement power supplies for XT-type computers, including the original IBM model. Be sure to get a replacement XT-style power supply if that's what your computer requires.

The most popular style fits AT-type PCs. This style covers a lot of ground, and is used in machines equipped with 286, 386, and i486 motherboards. The AT-style power supplies can be identified by their larger size, and recessed power switch. The switch on the XT-style models extends from the body of the power supply case.

If your computer is housed in a "tower" case, it'll use a special power supply that's both more costly, and more difficult to replace. In most tower cases, the switch is separate from the power supply. When replacing a tower-case power supply, you need to remove the power supply unit, and the switch. Use extreme caution and be sure the computer is unplugged before servicing! Or, you could receive a bad (and possibly fatal) shock.

Because they are not designed with generic parts in mind, the power supplies for the IBM PS/1 and PS/2 computers, as well as for most Compaq machines, are custom-made. You'll need to obtain replacements for these computers directly from the manufacturer, or from an authorized dealer or repair center. Expect to pay more than the cost of a generic power supply replacement. Average cost is about $200. ■

Buying a Second-Hand Computer

First there was I Can Get It For You Wholesale, and then there was Second-Hand Rose. Now PC Upgrade introduces our very own Frugal Techie. Each month he promises to save you money without being pennywise and pound foolish.

Pssst! Want a real bargain in a good computer? Forget those fancy computer showrooms. And don't bother with mail order outfits and computer swap meets.

The real deals are in used computers. At least sometimes.

As long as you don't need the latest and greatest, buying used equipment can save you 50 percent or more over purchasing the same goods new. And, like a new car that has to be tweaked by the dealer to get out all the kinks, a used computer has already been through the bug wash. In most cases, you can just buy it, plug it in at home, and start computing, right away.

Of course, buying a used computer takes some planning. After all, you don't want to be stuck with someone else's lemon. Here's how to avoid the citrus fruits and headaches in shopping for a used computer.

Finding the Deals

Used computers are most often advertised in the classified ad section of local newspapers. Check there first. If your area is serviced by a specialized ad paper—a publication expressly for the purpose of publishing classified ads of all types—be sure to look there, too.

Get the paper early, and scan the ads immediately. Don't wait, because the good deals go fast. Know what you're looking for before you start, so you can zero in on the ads that interest you the most. For example, if you're looking for a used IBM PC or clone, you can skip the ads for Commodore Amigas and Apple IIs.

Most ads provided a phone number. Call and get more details about the machine, like:

- How old is it?
- What other hardware—peripherals such as modems or printers—does it come with?
- Are you selling any software with it?
- Does it have a transferable service contract?
- Does it have any known problems (is anything broken)?
- Why are you selling it?

If the computer still sounds like a good bargain, get an address and make an appointment to see it. Don't wait too long: this is a first-come-first-serve business, even if you were the first person to call and make an appointment. If possible, try to see the computer immediately, or at least no later than the same day as your call.

What About Price?

If a price is mentioned in the ad, double-check it, in case there's a typographical error. Don't attempt to negotiate price on the phone, especially if the ad has just come out. The seller has no way of knowing if the computer will sell at the asking price, until he or she receives more phone calls and offers.

A popular computer listed at a reasonable price sells quickly—often a matter of just a few hours after the ad hits the streets, so don't count on haggling on price when the price is already more than reasonable.

That doesn't mean haggling is not recommended, or even unnecessary. Some sellers over-estimate the true value of their used computer, and try to sell it for just a few dollars off list price. Try to negotiate a better price if you feel the seller is asking too much. But be aware that some sellers are just too bone-headed to realized they've overpriced their goods. Don't waste your time arguing; go on to the next ad.

How do you know a reasonable price when you see one? That's a tough question, because you need considerale knowledge about computers and current prices to make an informed decision.

However, you can get a good idea about price by scanning the other ads. Calculate an "average" selling price for the same or similar model, taking into account extras like printers, monitors, and software. The better deals are the computers sold at or under this average.

You can negotiate price after you've personally seen the computer. If you feel the seller is asking a decent price, go ahead and pay it. But if you feel the price is too high, make an offer.

Buying Used From a Dealer

Odds are, there are some computer dealers that offer decent prices on used equipment, but I've never found them. Many computer dealers take in used gear on trade, but only a few attempt to resell the old equipment (they prefer to deal only in new stock). Instead, they sell if off to a middle-man, who in turn resells it to the public. All that changing of hands naturally leads to higher prices.

If you find a good bargain on a used machine at a computer dealer's or used computer resller's, then by all means buy it. But you'll probably have far better luck by sticking to private parties.

There are a few mail order used computer dealers. Some, like the Boston Computer Exchange, have been around for a long time, and offer a much-needed service. When buying mail order, rmember the extra cost of shipping. The shipping charges are potentially two way—you may have to send the computer back if you find you don't like it. Only occasionally canyou have the shipping shared refunded or reversed if the computer arrives damaged, or if it was not accurately descibed in the ad.

Avoiding the Lemon

Used computers don't come with a manufacturer's warranty, so there is no guarantee the beast will still be working a week from when you buy it. This is the single, largest risk of buying a used computer: what do you do when it breaks down?

There is no way to completely avoid a computer that someday cracks apart, but you can avoid buying a lemon in the first place. Look for signs of abuse and amateurish repairs. Avoid machines that appear like they've been on the repair rack one too many times.

Never buy a used computer without first turning it on, and personally testing it. If possible, turn the computer on and off a few times, and watch for any troubles it has starting up.

Arrange with the seller a limited "warranty": your money back if the computer breaks down in X number of days. You can try for seven or 14 days, but you may have to settle for just a couple of days.

Whether you pay by cash or check, be sure to get a receipt. The receipt should include the name of the seller, a phone number, the merchandise sold (all optional components should be itemized), and the selling price.

Free Software?

If the seller has included software (the software is already installed on the hard drive, for example), be sure to get the original diskettes and manuals. This might include programs like Lotus 1-2-3, WordPerfect, or Microsoft Windows.

If the seller doesn't have these, or refuses to give them to you, then you can consider the software not legally transferred to you. In that case, the software should not be considered in the price of the computer. Some sellers attempt to "sell" you software with the computer, while retaining the original diskettes and manuals themselves. This is illegal, and it also puts you in the awkward position of paying for something you don't really get.

A New Home

Once the computer is yours, feel free to make it your own.

If the previous owner installed a menu utility, redo it to suit your needs and tastes. Or remove it and replace it with something more to your liking.

Do the same with any applications programs that came with the computer, like word processors and electronic spreadsheets, as well as with the hardware. You may wish to start out with a clean slate: reformat the harddrive and install your own software from scratch. ■

Sourcing Computer Equipment

Anyone who has ever looked inside a computer knows that precious few of its component parts were actually made by the company whose name appears on the label. So how do manufacturers choose the sources of their parts? How does their choice affect price and quality? Is there any way you, the user, can have some control over what to buy?

by Nicholas Lavroff

Sourcing, part commerce, part science, and a sprinkling of art, is the Information Age equivalent of the great trade journeys of old, when mariners travelled to the Far East in search of spices and silks. But unlike the traders of yore, who were at the mercy of the elements, today's computer traders have only the economic climate to fear. Their job is to strike just the right balance between cost and quality, to optimize profit margins without increasing customer dissatisfaction or product returns. For today's computer sourcer knows that a penny saved at the source may end up costing much more than that if the goods turn out to be substandard.

Unlike a buyer, who might buy complete computer systems from a single distributer, a sourcer usually deals directly with a number of manufacturers, buying keyboards from one, monitors from another, and CPUs from a third, with a view to repackaging the components as a system under one label. To this end, a sourcer may travel to Japan for monitors, Korea for keyboards, and Hong Kong for motherboards; wherever he can get the best value for his dollar.

This article examines this central concept of value, and takes an inside look at the "real" cost of a computer system, from the time it comes off the assembly line in the Far East until it reaches the shelf in your local discount store.

Cost vs. Quality

As most informed consumers know, you get what you pay for. While price is no guarantee of quality, there exists a significant correlation between the two variables, a rule of thumb that can help a consumer make a purchasing decision without engaging in extensive research. But while this rule of thumb might work for a consumer making an occasional purchase, it is not much help to a commercial buyer who needs to optimize profit margins while keeping an eye on the customer satisfaction index. The commercial buyer needs hard data about the quality of the components he is considering buying, otherwise he may end up spending too much forthe components in the first place. Or he might buy cheaper components that turn out to be substandard, causing customer complaints and returns in the future. In either case, the buyer's profit margins will suffer, and with it, his job security.

The Far East

Today's computer sourcer can purchase equipment from manufacturers in Japan, Korea, Taiwan, Hong Kong, Malaysia, Singapore or the Peoples Republic of China. Each country has its own areas of specialization, and its own forms and levels of quality control. An experienced sourcer knows, for example, that to get the highest quality (particularly for monitors, keyboards, and notebook computers) you need to go to Japanese manufacturers. And that to get the lowest prices, you need to go to Hong Kong or Taiwan. The experienced sourcer is also aware that there are currently three tiers of manufacturers, and that the top two tiers, those earning $20 million to $100 million or more annually, are the ones most likely to produce the highest quality goods.

But these are just rules of thumb. A successful sourcer also needs to use empirical methods to judge the quality of the components he is buying.

Measuring Quality

One method is to negotiate for certain levels of quality as part of the agreement, in terms of a specific APR, or Acceptance Percentage Rate. Under this method, the shipment is tested upon arrival in the US, and if the sample tested falls below the APR, the importer has the right to refuse the entire shipment.

The most common method of testing the APR is the military standard known as MIL-STD-105R. Here is a typical example:

Suppose the sourcer contracts to buy 500 pieces of a component with an APR of 1.5% (which means that the shipment would be acceptable if no more than 1.5% of the components were faulty). Instead of testing the entire shipment, the importer can use MIL-STD-105R to test a much smaller subset, and then use statistical techniques to extrapolate to the whole. In this example, the importer need only test a total of 32 components. If three fail, the agreed-upon APR is not reached, and the importer can reject the entire shipment. If two (or fewer) fail, the shipment would be accepted. (Note that a failure of two units from a random sample of 32 does not mean that the APR has risen to 6%. MIL-STD-105R takes sampling error into account and uses statistical confidence interval techniques to arrive at the cutoff).

An APR of 1.5% is the most common in use today. Few contracts callfor an APR of less than 1%, since not many manufacturers would agree to such a stringent rate. At the other extreme, few contracts call for an APR of greater than 2%, since the rate of failures and customer returns would soon eat up any savings afforded by the more relaxed standard.

Not all importers use this method of quality control. Some of the bigger importers, such as IBM or Apple, have one or more employees stationed at the manufacturing plant, constantly sampling and testing components as they come off the assembly line. The advantage to this approach is that the importer does not waste time and shipping costs only to discover that the shipment is below standard. The disadvantage is the greater cost, which is why it is undertaken only by the bigger manufacturers, who are in a better position to pass the costs on to the consumers.

ADI's color monitor production floor in Taipei, Taiwan.

Generally speaking, regardless of the method of quality control, today's computer components are of a higher level of quality than ever before. With shrinking profit margins and increased competition, manufacturers cannot afford to gain a reputation for inferior goods. This spells good news for consumers, who are now enjoying the best of both worlds — good quality products at rock-bottom prices.

"Made in USA"

Not all computers are created equal. Some, for example, bear the legend "Made in USA", while others attest to more exotic origins like Korea, Taiwan or Hong Kong. First, what does it mean if a piece of computer equipment claims to be made in the US? And second, what bearing does this have on its underlying quality?

In today's recessionary climate many Americans prefer to buy American goods, feeling that this will help the balance of trade. What most buyers don't realize, however, is that a piece of equipment can consist of mostly foreign components and still be eligible to sport an American label. To qualify as Made in USA, the equipment must be assembled in the US from components 51% of which (by cost) were also manufactured in the US. For example, a CPU would qualify as Made in USA if it were assembled in the US, with an Intel chip and a Seagate drive (both American components which would make up more than 51% of the total cost). Presumably, the Seagate drive would also qualify as Made in USA by reference to the same criteria, which means that as much as 49% of the drive could consist of foreign components. Taken as a whole, therefore, it is possible for a piece of equipment labeled Made in USA to be mostly of foreign origin.

This suggests that a Made in USA label does not necessarilyguarantee a higher level of quality, or even an improvement in the balance of trade between the US and the rest of the world. The best that can be said is that a Made in USA label can help ease the conscience of a patriotic buyer. Indeed, some importers even argue that American workmanship has fallen below the standards currently in place in the Far East, and that a Made in USA label may actually signify inferior quality.

The Deal

What does a system really cost?

The following scenario is a typical transaction between an American importer and a manufacturer of computer components.

An importer contracts to buy one thousand 286 CPUs from a Korean manufacturer. The system includes a floppy drive and keyboard, but does not include a monitor or hard disk. The importer and the manufacturer agree to an APR of 1.5%.

The importer knows that labor costs in Korea are currently running about $2.90 per hour, and that the manufacturer's cost, including overhead and insurance, comes to $200 or more. The importer cannot afford to pay more than $250 per unit, and he knows that the manufacturer is unlikely to accept less than $225. They agree on a price of $235.

By the time the CPUs arrive in the US, they will have cost the importer about $250 apiece. (Middleman charges, insurance, shipping, interest, duties and a royalty to IBM add another 6-7% to the basic cost). By the time the importer adds a monitor and a hard drive, his cost per system is well over $400, and could exceed $500 if it includes a large-capacity hard disk and a VGA monitor.

The importer could have chosen to purchase the components separately and assemble them here for a Made in USA label. This would offer several advantages. First, the import duty for unassembled computer components is 2% (as opposed to 3.9% for the same components assembled abroad). Second, the Made in USA label may support a slightly higher price tag compared to goods assembled overseas. Third, domestic assembly poses slightly less risk, since the importer can assemble units in response to market needs rather than shipping quantities of assembled units (which thereby spend a large portion of their useful lives in transit). In fact, a smart importer will air-freight components that are more sensitive to technological advances (such as mother boards and display boards), and ship the rest by surface transportation.

The disadvantages of domestic assembly are the higher labor costs (which can run 5 - 15% of the total cost), and which can eat into the higher profit margin. Nevertheless, the bigger computer manufacturers,such as IBM and Apple, choose to produce goods labeled Made in USA.

Future Trends

Sophisticated consumers constantly weigh present needs against potential future savings. Should I buy now and get the benefit of present use, or should I wait in the hope that prices will drop? Of course, no one can answer that question with any certainty, since only the consumer can gauge his present needs. Nevertheless, the following summary might help the consumer derive a useful trend.

Eight years ago, a top-of-the-line IBM computer system cost about $5,000. The same holds true today. The difference lies in how much computer you get for your money. The top-of-the-line system of 1984 was a 4.77 MHz 8088 PC with a 10 megabyte hard disk and a monochrome monitor. Today's top-of-the-line system, by comparison, is a 80486 running at 33 mhz with a 200 megabyte hard disk (or greater) and a monitor capable of displaying 32,000 colors.

The change in the last eight years has been dramatic (about equal to the difference between a Yugo and a Rolls Royce) and will probably never be repeated again, certainly not in the near future.

With profit margins at their lowest, and with all other costs either rising or staying level, it is difficult to see how prices could go much lower. In fact, the only way manufacturers could legitimately lower prices would be by lowering quality or reducing the warranty periods, both of which introduce new risks for the consumer.

Less legitimate means, such as dumping, are available to less scrupulous players. Dumping is the practice of selling goods below their cost in the hopes of squeezing competitors out of the picture, and then raising prices later when there is less competition. Dumping is prohibited under the Federal Antitrust statutes, but is still practiced by some manufacturers. Whether or not such dumping will continue is a matter of opinion. Whatever the case, some commentators predict that prices will bottom out in the first two quarters of 1992, followed by shortages later in the year.

For the consumer, this suggests that the correct strategy is to buy the system you need within the next three or four months. Waiting beyond that will not get you a lower price, nor will it get you a better system for the same price.

The Changing Game of Computer Sourcing.

In the mid 1980s, sourcers travelled extensively to the Far East, in search of the Holy Grail of lower prices and higher quality. There they met with factory representatives, visited the clean, well-run manufacturingfacilities, and entered into agreements to buy computer components for the American market.

As the market grew and prospered, however, more and more manufacturers started sending representatives to the big American trade shows, such as Comdex and CES. Today, there is no longer any need for a sourcer to travel to the Far East to buy computer components. All he has to do is visit Las Vegas in the winter or Chicago in the summer, where he can take his pick from dozens of reputable manufacturers. In fact, some of the bigger manufacturers maintain offices in the key market spots around the world. The Taiwanese ADI Corp., for example has offices in San Jose, California, as well as in Holland and Thailand.

In any case, whether you choose to buy now or later, you should not lose sight of the fact that you are buying a consumer product, and that value, not simply price, is the most significant factor. ■

Dirt impairs electrical conductivity and can block your data.

Keep It Clean!

You've heard it before: Computers and dirt don't mix. Most PC users forget about keeping their machines clean and healthy. Instead, they use them day after day, oblivious to dirt, smoke, smog and soot piling up like landfills outside and inside their computer.

Sure, your computer is really a hearty beast, but it's also a fragile flower. They are, after all, nearly solid state in construction, with few moving parts. But the complexity of a computer is often taken for granted. Computers are very much delicate pieces of hi-tech machinery, and should be treated as such. Even the slightest amount of dirt, in just the right place, can be devastating.

The importance of caring for a computer can't be stressed enough, and sadly, most of us learn this fact the hard way: We pay a high-priced service tech a few hundred dollars or lose several days or weeks of work, because of a little ring around the collar.

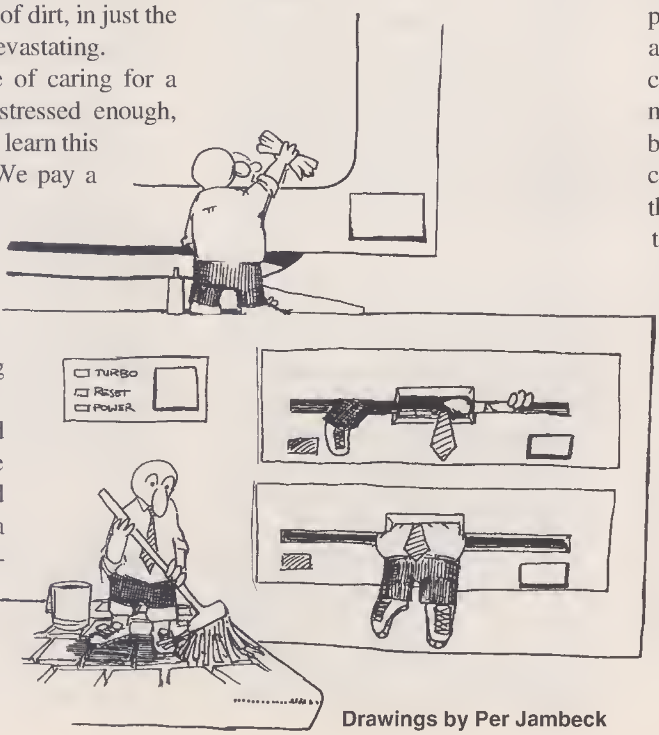
That's the bad news; now for the good: You can avoid the heartache of a dirty computer by taking some simple and inexpensive steps towards good computer health. Preventive maintenance and cleaning is all that's required to keep your computer in tip-top shape.

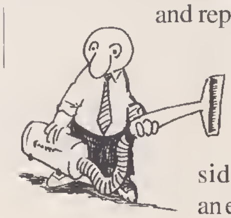
Dirt: The Unwelcome Guest

Dirt is everywhere, but it can't always be seen. Even the cleanest home or office is chock full of microscopically sized dirt, smoke, and soot particles—all floating around the air, ready to find a comfortable home outside and inside the PC. There's no way to avoid these atmospheric pollutants, but there are ways to minimize them. Getting rid of as much dust and dirt as possible is the first step in maintaining a computer system. To start: If the computer is used in a closed-environment office or home—where air is brought in through a centralized air conditioning system—make sure that the air vent is properly filtered, and that the filters are clean.

Most central air conditioners lack individual filters on the incoming vents; instead they are placed to filter the return air, before it is reintroduced into the system. For optimum results, then, the return airvent filters should be cleaned and replaced regularly.

For added protection, consider buying an electrostatic air cleaner,





Drawings by Per Jambeck

about a $100 investment. Some are wall mounted, but most units simply rest on the floor and don't require any type of installation. For maximum effectiveness, place the cleaner in front of or near the incoming air source. Electrostatic air cleaners actively attract dust, so the filtration materials used inside them can get grimy very quickly. Always be on the lookout for a dirty filter, and clean or replace it as directed by the manufacturer. New filters are generally $7 to $10 each.

And now a word of caution: Electrostatic cleaners work by discharging minute pulses of high voltage electricity. They shouldn't be used within six feet from the computer, or where magnetic media (diskettes, tapes, etc.) are stored. The electrical charge emitted by the cleaner may be enough to corrupt the data recorded on diskettes and tapes.

Human health considerations aside, smoking while using a computer invites trouble. If you smoke, you exhale directly into the computer, bathing it in tar and soot. The obvious solution is to not smoke while using the computer. If that simply can't be managed, try to direct the smoke away from the machine. Some more tips: Place the ash tray a few feet away from the PC (particularly the disk drives), not nearby where the excess smoke might curl its way inside the computer. And buy a tabletop fan-driven air cleaner ($20 to $50 at the local department or hardware store).

Be Your Own Environmental Protection Agency

Keeping the area around the computer clean helps cut down the amount of dirt that can contaminate the machine. Dust the computer itself, and tables, chairs, and other furnishings regularly, preferably every few days (more if visible dust collects more often). Of course, don't forget to vacuum the carpet or sweep the floor.

While not in use, it's a good idea to place a dust cover over the computer, disk drives, monitor, and all the other pieces of equipment. This makes sense because most machines are in use for just a small portion of the day (8 hours on; 16 hours off). Custom dust covers are available for most of the popular computers, printers, and terminals (see listings), but it may be necessary to buy a simple "cape" and drape it over the machine. While it may not look like much, it's the thought that counts. Incidentally, wipe off the cover every couple of days to remove any dust that may have settled on it. Covers are available from many computershows, office supply stores, and mail order outlets. They range in price from about $10 to $50.

> **"Overheated integrated circuits blow like firecrackers. . ."**

If a wood or kerosene stove or heater is anywhere near the computer, the job of keeping things clean will be a tough battle. Wood burning stoves and heaters, even the properly vented ones, give off ash and soot that eventually find its way to the computer. Kerosene heaters are even worse: They emit a fine spray of conductive oil that settles everywhere, leaving a slick film that's hard to remove. The film also acts as an excellent dust attractor. If you use a wood burning stove or kerosine heater, make it a point to clean the computer regularly, and try to place the PC away from the source of grime.

Many companies offer sprays to reduce the attraction that dust has for carpets, furniture, and computers. Most of the sprays aren't for use on the computer, but rather its neighbors: desk, chair, table, carpet, and so forth. Even so, a few anti-static sprays *are* available for application directly on the computer cabinet. But care should be exercised when using them. Some anti-static sprays may contain chemicals that unfavorably react with plastics. Before use, carefully read the instructions and try the spray on a small area of the cabinet.

More than dust eliminators, anti-static sprays, when used according to directions, can help reduce the chance of static charge buildup, which can be damaging to data recorded on disks as well as the delicate integrated circuitry inside the computer.

Outside Cleaning

Dust can never be fully avoided; some always seems to sneak by the best filters, anti-static sprays, and housekeeping measures. But routine cleaning of the computer—inside and out—can ensure that dust and dirt become nothing more than a passing nuisance. It may be surprising, but spending five to ten minutes a day keeping a computer in top-notch shape can literally add years to its life. A soft sable painter's brush is a must-have tool when cleaning the outside of the computer. Use it to gently wipe away excess dust, being sure to get inside all the nooks and crannies like air slots and in-between the keys on the keyboard. Hard to reach areas can be cleaned by using a can of compressed air, such as that offered by Falcon and Bib (available at both photographic and computer specialty stores). When using compressed air, blow the dust away from the computer; avoid pushing dirt further inside the machine.

And by the way, use only a commercially available clean-air system;never try to make do by using such things as a bicycle pump, paint compressor, or reversed-hose vacuum cleaner. With these, the air isn't clean to start. For the computer, it'll be like taking a bath in muddy water. While compressed air isn't cheap ($40 for a complete kit with nozzle, value, and cleaning jets; and $5 for refills), the investment is well worth it.

With the excess dust removed, wipe the exterior of the computer with a soft, lint-free cloth, preferably one that's been treated with an anti-static agent. Caked-on grime (from gummy labels, food, children, whatever) may need special attention. Try applying an all-purpose household cleaner and wipe up the residue with an anti-static cloth. If that doesn't help, use a recommended solvent-based cleaner; these are available at most computer stores like Egghead and CompUSA. Never use water!

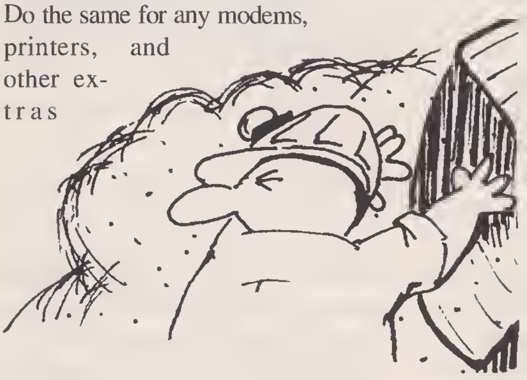
A smudgy and dirty CRT screen doesn't do much to hinder proper operation of a computer, but it can be annoying to the operator. The front surface of many CRT screens are plastic, designed specifically this way to provide anti-glare properties. Some tubes use an etched glass faceplace, and so can be cleaned with any general purpose glass cleaner, but most use either a separate plastic polarizing screen or a plastic laminate glued to the tube. Plastic front CRT screens need a special type of anti-static cleaner. Using just any old cleaner can result in scratching or melting the plastic.

A Thorough Cleaning Means Opening the Computer

External cleaning helps improve the appearance of the computer, and prevents the inevitable spread of dirt. But the real offender is dirt that's trapped inside the machine. Granted, there are few moving parts in a computer that could be damaged by a dirty mechanism. But the true danger lies not in mechanical components, but the electronic ones.

Dirt impairs electrical conductivity, reducing or blocking signals being sent from one part of the computer to the other. It also traps heat. Overheated integrated circuits blow like firecrackers, charring and ruining the electronics and inviting a fire. Under normal circumstances, internal cleaning should be done every six to 12 months, more if the unit is used in smoky or dusty environments.

Before cleaning the inside of your computer, be sure to turn it off, and unplug the power cord from the wall. Do the same for any modems, printers, and other extras connected to your PC.



Cleaning the inside of a computer means removing the cover. On most PCs, this isn't a problem: Just remove the screws on the back of the machine, or simply lift up the top. If you're not sure how to open your computer, consult the user's manual that came with it. Unlike the outside of the computer, solvents and liquids aren't recommended for cleaning circuit boards and other internal components. Instead, the sable brush and a can of compressed air is all that's usually required. (Incidentally, the compressed air can also be used to blow out any dust that may have collected inside a floppy disk or its paper storage pouch; just blast once or twice inside the pouch and through the opening of the diskette before and after use.)

Nearly all PCs use at least one fan (installed inside the power supply unit) for cooling. Look at the blades of the fan: Dirty blades spew dust in all directions. Be sure they're spotless. Likewise, cooling slots in the cabinet should be clean. Use a vacuum, brush, or can of compressed air.

When it's time to put everything back together again, take the time to make sure that all the connectors and boards are well seated in their connectors and slots. Push down on each gently but firmly.

How to Clean Disk Drives

There's nothing more critical to the operation of a computer than the cleanliness of the magnetic heads housed inside the disk drive mechanism. Disk drive heads aren't much different than those found in an audio tape deck, and as such, suffer the same maladies. When magnetic heads are dirty, they don't pick up a clear signal. With an audio tape deck, gummy heads create a muddy sound. With a disk drive, dirty heads can mean lost data or decreased performance.

Heads can become contaminated from cigarette smoke, dust, or grease and oil transferred from the user's hands to the floppy disk (which then comes in contact with the drive heads). Wear particles from the floppy disk itself—minute bits of magnetic oxide coating —are also a major source of read/write head contamination.

Computer and disk drive manufacturers used to be dead set against the consumer cleaning heads. Now, most major manufacturers not only suggest routine preventive maintenance on the drive heads, but stress it. The products developed for drive care enable the user to clean the heads in less than a minute without taking anything apart. The process is quite simple and relatively inexpensive. The per-cleaning cost for most of the head kits now out is between 50 cents and two dollars. This is in contrast to the $50 to $60 charged by most computer service technicians for a single cleaning and quick look-over.

Under normal office and home operation, your disk drives should be cleaned every 4-6 months; less if they aren't used often. (With most computers equipped with hard drives, the floppy drives are used only occasionally.) However, if the computer is used in dusty environments, or when disk drive errors seem persistent, increase the cleaning frequency. Using cheap, non-brand name diskettes can also mean that an increased cleaning frequency is required.

Most disk drive cleaning kits use a "cleaning disk" composed of nonwoven polyester. The cleaning disk is inserted into a plastic holder (either 5 1/4- or 3 1/2-inch, soaked with cleaning fluid, then popped into the disk drive).

Depending on the cleaning kit you use, the disks are either disposable after one use, or can be reused 10 or 15 times, or until they become noticeably worn or dirty.

Don't Forget the Keyboard

The keyboard receives perhaps the most abuse of any component on your computer. Over time, the recesses of the keyboard collect dirt, dust, hair, bits of food—you name it, and you'll find it in your keyboard. And when the keyboard gets dirty, the electrical contacts inside it are impaired. Press a key and it may not produce a character on the screen.

Fortunately, PC keyboards aren't expensive—under $50 for most models—but there's no reason to throw yours out every six months for a new replacement. The design of most keyboards allow you to disassemble them and clean them from the inside.

Let's take a closer look at how to keep your keyboard healthy, including how to diagnose problems, how to disassemble the keyboard, and how to carefully clean the keys. You'll also want to follow these steps if you've accidentally spilled liquid in your keyboard.

Assess the Damage

Before you attempt to repair or clean your computer's keyboard, you should assess the damage. If the keyboard is suddenly acting up, without any indication of rough use, first suspect your computer, software, or keyboard cable. Reset your computer or better yet, turn it off, wait a few seconds, then turn it back on again. Occasionally that will clear up the problem.

Be sure your software isn't the root of the difficulty. Some programs change the characteristics of the keyboard—even to the point of re-assigning keys. If your software lets you "re-map" the keys on your keyboard (switch the letters A and S, for example), turn the alternate keyboard assignment off, or reset your computer. Check that the keyboard cable is firmly seated in the connector at the back of the computer. You may need to turn the computer off, remove the cable, and clean the connectors. For cleaning, use any non-residue electrical cleaner, available at Radio Shack and most electronics parts stores. Dust and dirt can inhibit proper electrical connection, and that could cause your keyboard to operate unpredictably.

If your computer, software, and keyboard connector seem fine, you can suspect the keyboard. Look for signs of damage or foreign objects. TURN THE COMPUTER OFF and turn the keyboard upside down. Does anything fall out? If the computer has been used for any length of time, dust, dirt, and other crud can get caught under the keys. A light tapping on the back of the keyboard will often loosen the debris. For a heavy-duty cleaning job, clean the keys using a strong vacuum equipped with a soft brush attachment.

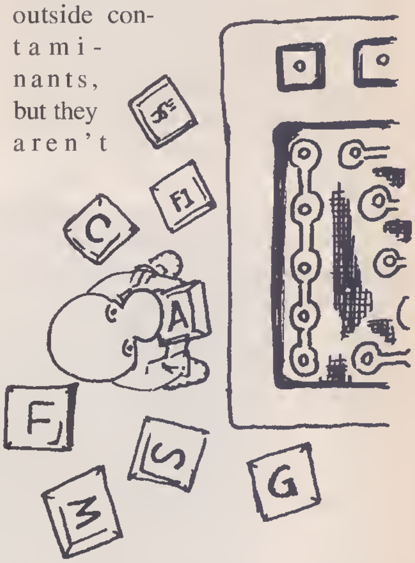
Disassemble the Keyboard

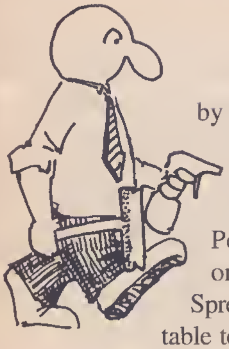
Assuming your efforts at fixing the keyboard haven't been successful, it's now time to disassemble the keyboard and work at the problem from the inside out. But first, a word of CAUTION: Taking your keyboard apart may void its warranty. If the keyboard or computer is still under warranty, you will probably want to return it to your dealer for repair.

Most keyboards currently used on PCs and clones share similar engineering: Most are constructed with a single, large printed circuit board. This circuit board contains few integrated circuits or other electrical components, but mainly consists of contact points for each of the keys on the keyboard.

Each key is composed of a plastic key top, a spring-loaded plunger, and a spongy-foam backed with a piece of metal foil. When you press a key, it pushes the metal foil against the contact point on the circuit board. That tells that computer that a key has been struck. Release the key and it springs back up, disengaging the electrical contact.

Only the expensive, high-end keyboards use individual electrical switches for each of the keys. These switches are usually sealed against outside contaminants, but they aren't water-proof—or cigarette-smoke proof. If your keyboard uses individual switches instead of the foam-metallic contactors, you may need to replace the defective switches. This process is beyond the scope of this article.





Begin disassembly by turning the computer off and disconnecting the keyboard from the back of the computer. Perform your surgery only in a well-lit area. Spread a soft cloth on the table to protect the keyboard and work surface, and be sure to save all parts as you remove them.

Temporarily touch a grounded metal object—the bare-metal case of your computer is a good choice. This helps drain the static electricity of your body, which reduces the chance of damage to the integrated circuits used in the keyboard.

Turn the keyboard over and locate the screws. Depending on the keyboard, you'll find four to eight screws, all recessed within the bottom cover. Remove them all. Set the screws aside (use a dish to keep the screws in one place), and remove the top half of the keyboard case. The keyboard itself will remain attached to the lower half of the keyboard case.

Turn the keyboard over (right side up) and remove the four screws that attach the keyboard frame to the case. Save these in a separate bowl.

Turn the keyboard over once more and locate the screws positioned along the back of the printed circuit board. There should be 18 to 24 of these screws, positioned at strategic points on the board. Since these screws are rather small, you may need a jeweler's screwdriver to remove them. Take care not to strip the top of the screw, or you'll never be able to remove it. As before, save these screws in a separate bowl.

Brush out the Keyboard

When all the screws are removed, carefully lift the circuit board up to expose the underside of the keys. You'll see the foil-capped sponges under each key. Watch for loose parts, like a sponge that has been disengaged from its key top.

Wipe the excess litter from the inside of the keyboard with a soft brush. If you spilled liquid into the keyboard, soak it up with a couple of paper towels. Water and diet sodas do the least amount of damage. These usually evaporate with little or no tell-tail trace. But coffee, tea, milk, and sugar-based drinks leave a residue that must be cleaned.

Use Cleaner to Get the Stubborn Grime

Wet a paper towel with isopropyl alcohol, and wipe the dust, debris,and residue from the electronic contacts on the printed circuit board. The contacts should be bright and shiny. Throw the towel away when you're done.

If you're cleaning spilled liquid, and that liquid has dried and is caked on, you may need to apply some electrical contact cleaner, available at Radio Shack (as well as most electronics outlet stores; look under Electronics-Retail in the Yellow Pages for electronics dealers near you). Be sure to get the kind of cleaner that leaves no residue or lubricant. NEVER use a cleaner/lubricant such as LDS or WD-40, since this will leave a non-conductive film inside the keyboard, rendering it useless.

Unfortunately, most electrical contact cleaners use hydro- fluorocarbons (specifically Freon), which have been found to disrupt the ozone layer of the Earth's atmosphere. So use this stuff sparingly.

Pour some isopropyl alcohol in a clean ceramic dish. Dip a cotton-tipped swab, such as a Q-Tip, into the dish, and carefully clean the metal foil on each key. Be careful that you don't pry the foil or sponge off, or you'll have to glue them back into place. You can use ordinary white glue, but apply just a dab. DON'T apply any glue on a contact surface—either foil or the printed circuit board—since this will impair the function of the keyboard.

After the cleaning is complete, leave the keyboard open for three to five minutes, to allow the alcohol to completely evaporate. Then, replace the circuit board, being careful to position the board correctly over the key tops. Reassemble the keyboard in the reverse sequence you took it apart in. Be sure to replace ALL screws. If you loose a screw, replace it with another one. Don't omit it.

Repairing Key Tops

Not all repairs require that you take the entire keyboard apart. If you loose or break a key top, you can replace it with a part from a discarded keyboard. You can often find old keyboards at computer swap meets and surplus electronics stores. Or, you may have one stashed in a closet or garage someplace. Use a medium flat-bladed screwdriver to pry up the keytop. Apply even pressure to avoid cracking or breaking the plastic. Press the new key top into place, and check to be sure that the key springs back into position after you press it. If the key doesn't spring back, the keyboard won't work properly.

Testing the Keyboard

When the keyboard is properly reassembled, reconnect it toyour computer and turn the machine on. Most computers include a power-on test that will warn you if the keyboard isn't functioning properly. If this warning appears, turn the computer off and inspect your work.

Assuming the keyboard passes the power-on test, wait until the computer displays the DOS prompt, then press every key. Look for characters that don't appear when you press their corresponding keys, or keys that "stick" and print a row of characters on the screen. For a more thorough job, obtain a keyboard testing program from a public domain or shareware clearinghouse. ■

In the next issue of PC Upgrade *we'll continue with maintenance tips for laser, dot-matrix, ink-jet and thermal printers.*

Building on the Cheap

Putting together the computer is the easy part. Becoming a savvy shopper who knows what to buy, where to buy it and what to pay is the part that takes a bit more experience. Read on to learn all about buying the right motherboard and matching it to RAM chips that run at the proper speed. Here you'll also discover how to correlate the capacity of a power supply to the requirements of your add-ons, what to pay for a computer case and how to figure cost per megabyte when buying a hard disk drive.

by Gordon McComb

Want a new PC but can't afford one? Build it yourself and save. The amount of money you trim from your PC bill is up to you. You can save a little, or

about computing.

The compatibility of these build-it-yourself clones is remarkably high. We regularly use several custom built clones to test new software and hard-

The Parts

The basic ingredients of a do-it-yourself clone are the motherboard, which includes the memory and all the computing electronics, power

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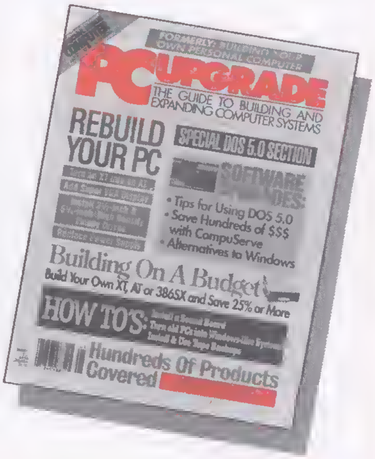

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- MORE MEMORY
- SUPER VGA COLOR
- TAPE BACK UP
- HIGH DENSITY FLOPPY DRIVES
- AND MUCH MORE!

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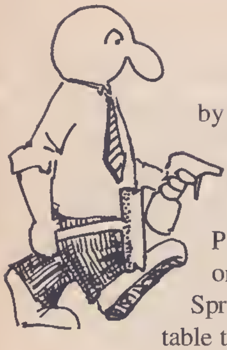

Begin disassembly by turning the computer off and disconnecting the keyboard from the back of the computer. Perform your surgery only in a well-lit area. Spread a soft cloth on the table to protect the keyboard and work surface, and be sure to save all parts as you remove them.

Temporarily touch a grounded metal object—the bare-metal case of your computer is a good choice. This helps drain the static electricity of your body, which reduces the chance of damage to the integrated circuits used in the keyboard.

Turn the keyboard over and locate the screws. Depending on the keyboard, you'll find four to eight screws, all recessed within the bottom cover. Remove them all. Set the screws aside (use a dish to keep the screws in one place), and remove the top half of the keyboard case. The keyboard itself will remain attached to the lower half of the keyboard case.

Turn the keyboard over (right side up) and remove the four screws that attach the keyboard frame to the case. Save th

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Wipe the excess litter from the inside of the keyboard with a soft brush. If you spilled liquid into the keyboard, soak it up with a couple of paper towels. Water and diet sodas do the least amount of damage. These usually evaporate with little or no tell-tail trace. But coffee, tea, milk, and sugar-based drinks leave a residue that must be cleaned.

Use Cleaner to Get the Stubborn Grime

Wet a paper towel with isopropyl alcohol, and wipe the dust, debris,and residue from the electronic contacts on the printed circuit board. The contacts should be bright and shiny. Throw the towel away when you're done.

If you're cleaning spilled liquid, and that liquid has dried and is caked on, you may need to apply some electrical contact cleaner, available at Radio Shack (as well as most electronics outlet stores; look under Electronics-Retail in the Yellow Pages for electronics dealers near you). Be sure to get the kind of cleaner that leaves no residue or lubricant. NEVER use a cleaner/lubricant such as LDS or WD-40, since this will leave a non-conductive film inside the keyboard, rendering it useless.

five minutes, to allow the alcohol to completely evaporate. Then, replace the circuit board, being careful to position the board correctly over the key tops. Reassemble the keyboard in the reverse sequence you took it apart in. Be sure to replace ALL screws. If you loose a screw, replace it with another one. Don't omit it.

Repairing Key Tops

Not all repairs require that you take the entire keyboard apart. If you loose or break a key top, you can replace it with a part from a discarded keyboard. You can often find old keyboards at computer swap meets and surplus electronics stores. Or, you may have one stashed in a closet or garage someplace. Use a medium flat-bladed screwdriver to pry up the keytop. Apply even pressure to avoid cracking or breaking the plastic. Press the new key top into place, and check to be sure that the key springs back into position after you press it. If the key doesn't spring back, the keyboard won't work properly.

Testing the Keyboard

When the keyboard is properly reassembled, reconnect it toyour computer and turn the machine on. Most

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THE GUIDE TO BUILDING AND EXPANDING COMPUTER SYSTEMS

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Building on the Cheap

Putting together the computer is the easy part. Becoming a savvy shopper who knows what to buy, where to buy it and what to pay is the part that takes a bit more experience. Read on to learn all about buying the right motherboard and matching it to RAM chips that run at the proper speed. Here you'll also discover how to correlate the capacity of a power supply to the requirements of your add-ons, what to pay for a computer case and how to figure cost per megabyte when buying a hard disk drive.

by Gordon McComb

Want a new PC but can't afford one? Build it yourself and save. The amount of money you trim from your PC bill is up to you. You can save a little, or you can save a lot, depending on how you go about it. Done right, you can enjoy savings of hundreds of dollars or more, depending on the machine you build.

By being your own computer maker you solve one of the biggest problems of PC ownership — rising costs. Instead of buying a PC compatible already put together, you buy the pieces and hook them up. The parts come prewired, assembled, and complete; there's no soldering involved. A screwdriver is the only tool necessary for assembly. Building a PC isn't for everyone, of course, but for those ready for the minimal challenge involved, it's a good way to save lots of money — and learn more about computing.

The compatibility of these build-it-yourself clones is remarkably high. We regularly use several custom built clones to test new software and hardware.

Here's what you need to put together your own IBM PC clone, while keeping an eye on costs. You'll learn how and where to get the parts, along with how to separate the come-ons from the good deals. The basic instructions we provide here should be enough for you to assemble your clone, but you'll want to refer to the instruction manuals included with each computer component for more specific details.

The prices we provide for the various components are ballpark figures to help you gauge the potential costs and savings. Use the prices as a guide only. Prices go up and down depending on supply and demand.

The Parts

The basic ingredients of a do-it-yourself clone are the motherboard, which includes the memory and all the computing electronics, power supply, case, keyboard, disk drive and controller card, and video adapter and monitor. Options are a second floppy disk, a hard disk, and parallel and serial ports. These "options" in fact are highly desirable, and as even entry-level computers come equipped with these features, we'll consider them part of the package.

Let's take a closer look at the basic ingredients.

Motherboard

The motherboard is the key component of your computer. At the heart of the motherboard is the microprocessor, which does all the thinking and calculating. The motherboard also contains the memory, support circuitry, and slots for expansion boards. More about these in a bit.

Motherboards come in a variety of flavors and prices vary from a low of $35 to over $1,000. The wide disparity has to do with capability. The cheaper motherboards use older designs and are slower. The more expensive motherboards are equipped with the latest microprocessor and have speed rivaling mini-computers and some mainframes.

At the bottom end of the motherboard totem pole are those equipped with an Intel 8088 microprocessor. These are modeled after the original IBM PC and XT. The motherboards come in three popular "speeds," expressed in megahertz (MHz, or cycles per second). The faster the speed of the motherboard, the more computations it can do in one second. The speeds are 4.77, 8, and 10 MHz.

It's rare to find 4.77 or 8 MHz motherboards (and they aren't recommended, due to their slow speed), though you can still find the 10 MHz "turbo" models. If your aim is to build an inexpensive "starter" machine, or perhaps as a workstation or a second computer, 10 MHz 8088-based motherboard is a good choice. Prices start at about $80. This doesn't include memory (discussed below).

If you plan on using heavy-duty software, like Lotus 1-2-3, WordPerfect, or Windows, you'll need a AT-class PC. These use an Intel 80286 microprocessor. Common operating speeds for AT-class motherboards are 12, 16, and 20 MHz. The 12 and 16 MHz models are the cheapest — about $100 and $130 respectively — though you get better performance with a 16 or 20 MHz model. Like the 10 MHz 8088 motherboard, the 12 and 16 MHz AT-class motherboards are great for use a starter machine. You'll enjoy a 200 to 300 percent performance increase with a 12 MHz AT-class motherboard over the 8088 model, and for not much money. And you'll squeeze out even more performance with the 16 MHz model. The extra couple of dollars are well worth it. You'll have plenty of other chances to save with other components.

What about the 20 MHz AT-class motherboard? Our recommendation is that you avoid it, as its cost/performance ratio makes it a poor deal. For not much more, you can purchase a board equipped with an Intel 80386SX, running at 16 or 20 MHz, and enjoy far better performance.

The 80386SX microprocessor is really the "little brother" to the more powerful and very popular 80386 (officially known as the 80386DX). A 20 MHz 80386SX motherboard costs about $200 mail order, and provides perhaps the best balance between price and performance. It can be used torun all the latest software, and it's fast enough that you won't be caught behind the keyboard twiddling your thumbs.

The 80386SX motherboards are also available in a 25 MHz model, which provides a little more speed for computation- intensive applications. Depending on the source, it doesn't cost that much more than the 20 MHz model. However, if the price difference is more than $50 or so, pass it up.

Prices for motherboards jump dramatically when you cross into the 80386 (DX) threshold. For example, a no-frills 80386, running at 25 MHz, costs about $300, a full hundred bucks more than the SX version. Sure, you get better performance, but you'll have to decide if it's worth it. Costs skyrocket even more for the 33 MHz models, as these are typically engineered with high-speed cache memory. This is special memory set aside for the use of the microprocessor. A 386-33 motherboard, equipped with 64K of cache, costs about $400.

At this time, we do not recommend building a PC with the latest Intel 80486 microprocessor — either the DX or the SX version. The 80486-equipped motherboards still carry a still premium, and you can often purchase an already-assembled computer for the same or less money.

All clone motherboards are equipped with six to eight expansion slots, so you can use standard PC add-on boards with them.

Most also come with an empty IC socket so you can add an optional math co-processing chip (exception: 80486DX motherboards; the DX version of the 80486 has a math co-processor function already build in). You need to match the math chip with the main microprocessor in the computer:

Main processor	**Math co-processor**
8088	8087
80286	80287
80386	80387
80486SX	80487

Math co-processors for the 80286 and higher microprocessors aren't cheap, so if you're on a tight budget, omit it for now. You can always add it later, simply by opening the computer, popping the math co-processor chip into the socket, and resetting a jumper or two on the motherboard.

Random-Access Memory

Motherboards seldom come with memory already installed, and the prices quoted above are for boards sans random access memory (RAM). Theamount of memory you install will depend on the type of motherboard, and your projected use.

Motherboard	**Typical maximum RAM capacity**
8088	640K
80286	2 megabytes
80386	4 or 16 megabytes
80486	8 or 16 megabytes

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RAM prices have been fairly steady for the past few years, and average about $50 per megabyte. Memory prices vary depending on the access speed of the chips. The access speed is a measurement of the *slowest* time it will take for the RAM chip to deliver a piece of information once it is requested to fetch it. Faster RAM will *not* make your computer run faster, but slow RAM may make it run slower (or not at all).

The speed of the RAM chips is expressed in nano-seconds, or billionths of a second. Following are the recommended minimum speeds for use with various motherboards. There is NO NEED to buy faster RAM, so save your money and purchase just what you need. (Note: these figures are conservative and are based on standard motherboard implementations; check the documentation that comes with the motherboard you are buying for the recommended RAM chips to use.)

Motherboard Type/Speed	RAM Speed (nanoseconds)
8088, 4.77 MHz	200
8088, 8 MHz	150
8088, 10 MHz	120
80286, to 20 MHz	100
80386, 16 or 20 MHz	100
80386, to 33 MHz*	85
80386, to 40 MHz*	70

** Also applies to SX versions, and 80486; assumes microprocessor cache.*

ROM BIOS Chip

Most motherboards come with the ROM BIOS (Basic Input/Output System) chip already installed, and part of the price. However, not all do. One way to trim the sale price of a motherboard is to leave out the BIOS, which is absolutely necessary to operate the computer. When comparing prices, be sure that the motherboard is ready to go (except RAM, which you can price separately).

If you have to buy the BIOS chip separately, it'll cost another $50 to$100, depending on the source and the brand.

Motherboard Built-Ins

You can often shave $50 to $85 off the overall price of your do-it-yourself clone by purchasing a motherboard already equipped with an integral hard drive controller, one or more serial ports, and a parallel port.

If your motherboard lacks these, you'll need to add them as separate expansion cards. This entails extra cost, and also consume one or more precious add-on slots on the motherboard.

A good number of 80286, 80386, and 80486 motherboards now come with hard drive controller circuitry built in. The circuitry supports IDE hard drives, which are among the fastest and most popular. The IDE standard places most of the controller circuitry on the hard drive itself, minimizing the circuitry on the motherboard. Even so, if the motherboard already supports an IDE hard drive, you'll save $35 to $50 on the price of a stand- alone IDE controller card. In most cases, an IDE-equipped motherboard costs only $10 or $15 more than one that isn't, if there's a price difference at all.

A growing number of motherboards are also equipped with the circuitry to support high-density floppy drives (see below for more information on floppy disk drives). Again, buy purchasing a motherboard that already provides the circuits for a pair of floppy drives, you save the space of a dedicated expansion board, and perhaps $25 or $30.

Fewer motherboards come with parallel and serial ports, but a few do. If you know you want at least one of each, look for a motherboard that already provides them, and you'll save a couple of dollars. Expansion cards for serial/parallel ports are relatively cheap (in the $20 to $40 range, depending on capabilities) but again if you can save the money and space by consolidating, by all means do so.

Power Supply

The power supply does as its name implies: it supplies highly regulated power to the various components in the computer. Power supplies for PC clones are self-contained units, usually (but not always) UL approved, and always contain a 12 volt ventilation fan to help keep the computer cool.

Power supplies are rated in watts, which loosely speaking is the amount of electrical power that can be delivered to the computer system. The higher the wattage, the morc components the power supply cansupport. Power supplies for clones come in a number of general sizes:

- 150 watt — recommended for XT and small 80286 systems with a small (under 80 megabyte) hard drive.
- 200 watt — recommended for larger 80286 and 80286 systems, with average size hard drives (80 to 350 megabytes).
- 275 to 300 watt — recommended for "feature-laden) 80386 and 80486 computers, with large hard drives (over 350 megabytes).

A good rule of thumb is that an empty 80286-equipped or higher computer consumes about 50 watts of power. Each floppy disk drive consumes another ten. Expansion boards gobbler about eight to 12 watts each (figure 15 watts each to be on the safe side). A computer equipped with three expansion boards, two floppy disk drives, and no hard disk drives consumes about 85 watts.

Hard drives consume copious amounts of power, and you should figure on about two watts for every 10 megabytes (this figure varies widely depending on the drive type, but is acceptable for rough computations). Therefore, a 120 megabyte hard drive consumes about 25 watts.

Also consider that RAM con-

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DS/HD 5¼ 1.2MB

sumes memory. Calculate about two watts for each megabyte. Will eight megabytes or less of memory, the power consumption is not a critical issue. However, at 12 or 16 megabytes, the added wattages can build up — 16 megabytes of RAM will consume roughly 35 to 40 watts of power.

One of the greatest mistakes you can make in building your own PC is selecting a power supply that is too small. It's better to purchase the most capable power supply you can, keeping within your budget limits. However, there is no reason to go overboard. If you figure your system will consume about 150 watts of power, there's no need to spend extra on a 300 watt unit. However, you'd do well to purchase a 200 watt model, to allow yourself some room to grow. The price difference is minimal: a 150 watt model costs about $45 to $50, and a 200 watt model about $15 or $20 more.

Case

Here's where you can save a lot of money. A no-frills desktop case for an 80286 or higher computer costs about $40. A small, no-nonsense tower model (these sit on the ground by your desk, rather than on your desk), without power supply, runs about $65 mail order. The large tower model generally come with a 200+ watt power supply, and cost start at about $135.

A number of manufacturers like to put all sorts of bells and whistles on their cases. Most include a key lock and reset button, and both are worthwhile and recommended. But avoid the cases with digital read-outs to tell you the speed of your computer. The read-out doesn't really measure anything, but uses pre-set values depending on the mode of your computer. (Most fast computers have a standard "turbo" mode where it operates at top speed; slower speeds are supported so you can run some software. However, the slow speeds are seldom required these days.)

Avoiding a fancy case can save $20 to $30, and make the assembly job a little easier, because of the fewer circuits to connect.

When choosing a case for your clone, make sure it has the proper cutouts for the components you are using. This includes the power supply, power supply switch, power cable, keyboard connector, and expansion boards. Though most cases are designed for generic components, some are engineered for specific parts (and therefore, may be sold at a too-attractive price).

Floppy Disk Drives and Controller

Few computers can do without a floppy disk drive. To add one or more to your clone, you first need a floppy disk controller card (or else a motherboard equipped with the proper circuitry to support floppy drives). Average price for a two-drive floppy controller is $45. This circuit board plugs into one of the empty slots on the motherboard and supports from two to four floppy disk drives. The controller card, like almost all other expansion boards for the PC clone, derives it power through the motherboard. You just plug it in to an empty socket and you're set.

The floppy disk drives connect to the controller by way of a large ribbon cable. Unlike the controller, the drives themselves connect directly to the power supply. Most power supplies have two or four special cables to provide power specifically to the disk drives.

Drives for PC clones come in several sizes and types. The most common is the double-sided, high-density (DS/HD) half-height drive (cost: about $75). These store up to 1.2 megabytes of data on a single diskette, and also support the lower density 360K 5 1/4-inch floppies.

If you use DOS version 3.3 or later (which you should), you can also use 3 1/2-inch high-density floppies (also about $75). These store up to 1.44 megabytes of data on a single diskette, and also support the lower density 720K 3 1/2-inch floppies.

We recommend you install one each 5 1/4- and 3 1/2-inch high capacity floppy disk drives. Both can be attached to the same controllercircuitry. The dual media will assure that you can use any diskettes used for distributing IBM PC data or programs. You'll still be able to copy diskettes by using the same drive as the source and destination.

Hard Disk Drive

Hard disk drives used to be optional on PC clones, but they have become a necessity these days. Few programs — even games! — are sold these days that do not require a hard drive.

Hard drives come in a variety of types and sizes. By size we mean the data capacity of the drive, stated in megabytes. The minimum practical size of a hard drive for an XT or AT computer is 40 megabytes, though we recommend 60 or 80 megabytes. If you plan on using Windows and more than one or two Windows applications, our minimum recommendation is 120 megabytes.

Hard drives also differ in the technology they use to transfer and record data. Here's a quick run-down:

- ST-506 — The oldest style, uses a relatively wasteful recording technique that wastes hard disk real estate. Transfer times, that is the time it takes for data be sent between the computer and the hard disk — is relatively slow. The ST-506 hard drives are among the cheapest, however, and represent a good bargain if you're on a budget. You will have to live with less-than-sterling efficiency, though.
- ESDI — Uses an improved data transfer scheme and more efficient electronics to make more data

on the hard disks. With the growing popularity of IDE type drives (see below), ESDI drives are now becoming cost effective only for very large units, such as 350 megabyte models.

- SCSI — Similar to ESDI, but uses an "industry standard" for connecting the hard drive to a centralized controller. In reality, few SCSI drives are freely interchangeable with other brands of controllers. Of the three mentioned so far, SCSI drives offer the best all-around efficiency and speed.
- IDE — A latecomer, offers many of the same benefits of ESDI and SCSI drives, but at a lower overall costs. If you're building a PC, an IDE hard drive is the recommended way to go, especially if your motherboard already contains the controller circuitry to support an IDE drive.

Unless you're building a super-duper 80386 or 80486 PC, you'll find the hard drive is the most expensive single component in your computer. Accordingly, you should take the most time to select just the right one. Consider carefully the size of drive you need, and the best type (ST-506, SCSI, ESDI, or IDE) for your system.

Prices for hard drives vary widely, depending on size, speed, type, and manufacturer. For example, you might be able to find a 60 megabyte IDE drive made by Quantum for about $240. Up the size a bit to 80 megabytes and the cost jumps to $290. Another 40 megabytes (120 megabyte model) costs about $375.

Note that the price per megabyte of storage gets lower as the size of the drive increases. By dividing the price of the drive by its size you can get a clearer idea of its basic cost. Compare the average price-per-megabyte costs against the drives you're considering (all assume IDE type drives):

Drive size	Average cost per megabyte
40 MB	$4.40
60 MB	4.00
80 MB	3.60
120 MB	3.15
150 MB	3.00
240 MB	2.50

For example, if you find a 240 megabyte hard drive for $700, and are it's a good deal, you have only to divide $700 by 240 to find that the price per megabyte is $2.91, considerably higher than the average. To justify the higher price, that drive better come with added features (better speed or brand reputation, for example), or you know to keep looking for a better bargain.

Display Adapter and Monitor

You'll need a monitor to see what the computer is doing. To hook up a monitor to the PC clone, you'll need a display adapter card. These cheapest is the 12 or 13 inch monochrome, which retails for about $80.

If you want color, there are two basic standards to choose from: EGA and VGA (the older CGA standard should be considered due to its poor resolution). Of two two, VGA offers a sharper picture with more colors. As the price difference between EGA and VGA monitors is not great, and most software publishes these days favor the VGA standard, we recommend you go with a VGA monitor.

Cost is about $220 for a no-frills 14-inch VGA color monitor. You can spend more for a monitor with increased resolution (you need a graphics card, discussed below) to use this feature, however. VGA monitors are often listed by size and "dot pitch."

- Size is the diagonal measurement of the picture tube. A 14-inch screen size offers a good trade-off between image size and cost. The image on a smaller monitor may be harder to see, and a larger monitor is more bulkyand expensive.
- Dot pitch is the minimum measurement, usually in millimeters, between two same-colored dots on the surface of the picture tube. The smaller the dot pitch, the finer the image. A standard and quite acceptable dot pitch is .35 mm. The picture is sharper on a monitor with a dot pitch of .31 or .28 mm; but the cost is substantially higher. Rather than the average $220 for a .35mm VGA monitor, cost of a .28 model is about $350.

You'll need a graphics card to connect the monitor to your computer. Typical costs for a standard VGA graphics adapter is $100.

The type of card should match the monitor you have. If your VGA monitor is capable of only the standard VGA resolution of 640 (horizontal) by 480 (vertical) pixels, there's no reason to purchase a graphics card that provides a higher resolution (exception: if you plan on upgrading your monitor to super VGA some day).

On the other hand, to take advantage of the higher resolution supported by some VGA monitors — some go as high as 1,024 by 768 pixels — you need a graphics card that can provide that resolution.

In our opinion, more money is wasted on high resolution VGA monitors and graphics cards than any other single element in a PC, do-it-yourself or otherwise. Unless you specifically need higher resolution (you're involved in desktop publishing or graphics work, for example), we suggest you stick with the standard 640 by 480 resolution. If you want to add pizzazz, get a VGA graphics card that provides 256 simultaneous colors, instead of the usual 16.

Most VGA graphics cards can provide for 256 colors, often just by adding more on-board memory (typical cost is about $50 for the additional memory).

Note that many software packages, such as Windows, support high resolution and more colors, but often at the penalty of speed. You should consider this when buying the parts of your computer.

Input/Output

Unless the motherboard you use already comes with its own parallel and serial ports, you'll need to add them using a dedicated expansion board. A combination serial/parallel board, with two serial ports (COM1 and COM2) and one parallel port (LPT1), costs in the neighborhood of $30. Many serial/parallel boards also come with a game port, so you can connect a joy stick to your PC.

Keyboard

Completing our do-it-yourself PC is a keyboard. This attaches to themotherboard by a connector on the back of the case. You can buy any of several keyboards for your computer, and choose the one that you like best. The basic keyboard looks just like the one found on the IBM PC. These are usually referred to as "5150-style," after the model number of the PC.

Some people don't like the placement of some of the keys on the 5150 keyboard. If you're one of these, you can get a Keytronics 5151 (or equivalent) keyboard. With this model, the function keys are located along the top, larger return and shift keys, and a separate cursor pad. Still another version of keyboards imitates the key layout of the PC/AT, and is most often used with 80286, 80386, and 80486 computers.

Keyboards for clones start at about $50, though you can buy some cheap brands for a little as $30. If you plan on using the keyboard only sparingly, a low-cost keyboard is an effective alternative. However, if you think the computer will receive more than an hour of use every day, opt for a better keyboard. The keyboard will last longer and will have a better "feel" to it.

Specialty keyboards, like the 101 and 102 key Northgate Omnikey cost more — $75 to $85, and some "tactile feedback" keyboards cost as much as $200. Some people consider the quality of the keyboard very important in the usability of a computer. If you don't care one way or another, save your money and get a $50 model. Otherwise, shop around to find the one you want, but be prepared to pay a higher price.

Where to Buy

Because build-it-yourself clones take a big bite out of the sales of the IBM PC and brand-name clones, you can bet that your local ComputerLand won't stock the components. Building blocks for PC clones are available through three basic sources: specialty stores, mail order, and computer swap meets.

Specialty Stores

Hundreds of electronics outlets across the country, except for the Radio Shack chain, offer clone parts. If they don't advertise in the local newspapers (be sure to check the Sunday edition, especially in either the business and sports sections), refer to the Yellow Pages for leads. Look under Electronics — Retail. The ads in the Yellow Pages probably won't say anything about "Clone Parts," so you'll need to call a handful to locate those outfits dealing with build-in-yourself IBM PC compatible computers.

Buying clone components from a speciality electronics store has its advantages and disadvantages. On the minus side, prices are usually higherthan mail order and swap meets, because the overhead of the store is higher. On the plus side, you have a much greater chance of getting personal attention and help in case you have a problem.

Mail Order

Most clone components are purchased through the mail. Ads for clone parts are found in this magazine, among others. When buying by mail, call or write for a current price list. Most magazines have long advertising lead times (the time it takes to place an ad and when it appears), and prices may change.

Check back issues of the magazines to see how long the company has been advertising. It's a good idea to stay away from companies that have been advertising less than two or three months. Although they are probably legitimate, you'll have better luck sticking to older, established firms.

Most mail order firms accept charge cards and COD. These methods of payment are preferred, especially with newer companies. There's less chance of your money going astray. Some companies add a small surcharge to COD, so remember to add it to the total when the package comes.

A number of mail order outlets also have a walk-in store. If you live near one of the stores, make it a point to go in and check out the operation and the merchandise.

Swap Meets

Computer swap meets are becoming more and more popular. They bring together, under one roof, dozens of merchants selling computer hardware, software, and peripherals, and at cut-rate prices. Some of the merchandise is used, but much of it is new, imported directly from Japan, Hong Kong, or Taiwan.

When buying clone parts at a swap meet, try to choose a merchant who also has a store. In that way, you'll get better service in case of a problem. Failing that, get the merchant to provide a telephone number for technical support. Always get a money back guarantee, and always get a receipt. Inspect the components prior to leaving. You should reject merchandise that's obviously damaged or used, unless you're buying it as such.

Putting the Pieces Together

Putting your clone together is a relative easy task. You need a work table, good lighting, and two screwdrivers — one Philips (#1) one flat head. Optional tools that make the work easier and go faster is a pair of pliers and an IC insertion tool (Radio Shack catalog # 276-1574; $6.95). You DO NOT need a soldering iron or specialty electronics tools.

Before assembling the computer, read the instruction booklets that came with all the components. Familiarize yourself with how things go together. Some parts may not come with assembly instructions. If you're not *sure* how a component fits into the computer, go back to the dealer and ask for help.

Following are specifications and prices for three sample systems. Prices are average mail order; the prices you obtain may be higher or lower. Remember: when comparing prices, compare *all* the system components, including memory, floppy drives, hard drive, and display.

System #1 — 80286/20 MHz

Item	*Price*
286-20 motherboard, with ROM BIOS, 0K RAM	$ 115
2 MB RAM	74
AT style case	48
5 1/4-inch 1.2MB floppy drive	59
3 1/2-inch 1.44MB floppy drive	59
40 MB IDE hard drive	185
Floppy disk/IDE hard disk controller card	54
150 watt power supply	37
Keyboard	29
14-inch Monochrome monitor	79
Monochrome display adapter	30
Parallel/serial/game port card	22
TOTAL SYSTEM	**$ 791**

System #2 — 80386SX/20 MHz

Item	*Price*
386SX-20 motherboard, with ROM BIOS, 0K RAM	$ 200
2 MB RAM	74
AT style case	48
5 1/4-inch 1.2MB floppy drive	59
3 1/2-inch 1.44MB floppy drive	59
80 MB IDE hard drive	275
Floppy disk/IDE hard disk, I/O card	65
230 watt power supply	50
Keyboard	49
14-inch VGA color monitor	219
VGA display adapter	69
TOTAL SYSTEM	**$ 1,168**

System #3 — 80386/33 MHz

Item	*Price*
386-33 motherboard, with ROM BIOS, 0K*	$ 375
4 MB RAM	152
Mini tower case	65
5 1/4-inch 1.2MB floppy drive	59
3 1/2-inch 1.44MB floppy drive	59
130 MB IDE hard drive	360
230 watt power supply	50
Keyboard	49
14-inch high-res VGA color monitor	295
VGA high-res display adapter	89
TOTAL SYSTEM	**$1,553**

** With embedded IDE hard drive controller, dual floppy drive controller, two serial ports, one parallel port*

Some sellers of PC clone parts providc an overall instruction manual to help you in putting your computer together, but it's our experience that few do.

After you've studied the assembly instructions, double check to make sure that you have all the parts. Be on the lookout for stray screws, bolts, and cables. Familiarize yourself with each part and examine how it fits into the computer.

Following is a short step-by-step guide on building your own PC clone.

Step 1 — Install power supply. Install the power supply into the case, using the screws provided. Make sure the AC sockets, ventilation fan, and on/off switch line up properly with the corresponding cutouts in the case.

Step 2 — Install memory chips into motherboard. Insert the RAM chips into the sockets of the motherboard, as required. Be sure to observe the proper orientation of the chips (or modules) so you don't install them backwards. If you do, you run the likely risk of damaging the memory, and possibly the motherboard.

Step 3 — Install the ROM chip. If the motherboard doesn't already include it, insert the ROM chip(s) into the appropriate socket.

Step 4 — Install motherboard. Install the motherboard inside the case. Be sure to use the insulating washers on the top AND bottom of the board, if provided (failure to use the insulating washers could seriously damage the motherboard). Fasten all nuts and bolts together before tightening them.

Step 5 — Connect power to motherboard. Connect the one or two power connectors from the power supply to the motherboard. Be certain the connectors are properly oriented or the motherboard may be seriously damaged.

Step 6 — Install disk drives. Install the floppy and hard disk drives. Start with the hard drive, if possible, then install the B floppy drive, then the A floppy drive (by convention, the A drive is on top; the B drive is on the bottom.

Install the floppy drives so that the disk clamping mechanism is onthe top (with most drives, the bulk of the control circuitry will be on the bottom). The indicator lamp on the front of thc drive should be on the top. Using the drive upside down may cause it to not work properly. The design of some cases may require you to use a right-angled screwdriver to properly secure the drives.

Connect the power leads from the power supply to each disk drive. The power connectors are keyed and attach one way only. If the power supply in your computer has only one cable for the drives, you will need to use a "Y" power tap. The tap splits the one cable into two, so you can feed two drives.

Step 7 — Install controller cards). Install the floppy and hard disk controller cards, as needed. Attach the signal cable from the controller card to the drives. Most cables for floppy disk drives have three connectors. One will be by itself at one end of the cable; the other two will be at the other end of the cable. Attach the single-end connector to the controller card (it is keyed and will fit in one direction only).

The two remaining connectors attach to the disk drives. The connector at the very end of the cable attaches to the A: drive; the other connector attaches to the B: drive. The disk drives will not work if these connectors are reversed, but no damage will occur.

Step 8 — Install expansion boards. Install the other expansion boards into the remaining slots. At the very least, you'll need a display adapter card, connected to the proper type of monitor. You may also add I/O boards, internal modems, hard disk drive controllers, hard disk drive cards, etc.

Step 9 — Install the keyboard. Attach the keyboard to the round connector located at the back of the case.

Step 10 — Inspect work. Double check your work to make sure that all of the components are installed correctly. Be especially wary of ROM and RAM chips inserted backwards, and cables that are attached incorrectly.

Step 11 — Start computer and test. Plug the computer into an AC outlet and turn it on. After a few seconds, a flashing cursor should appear on the screen. The ROM chip used in most clones has a built-in diagnostic routine that looks for problems. An error message will appear on the screen if the ROM chip detects a problem.

If all is okay, the computer will try to access the A: drive (the light will go on). Since no disk has been inserted, you will get the message telling you to insert a system disk. Insert a DOS disk into drive A: and restart the computer (or tap a key if instructed to do so). The computer should boot up and read DOS off the disk.

Once the A: prompt appears, insert a disk into drive B: (if installed), change drives, and type DIR to get a directly listing. If the drive does not respond, the drive may not be connected correctly, or it may be improperly terminated.

Log back onto drive A: and type CHKDSK (CHKDSK.COM must be on the DOS diskette). The program will tell you how much memory is in the computer; the figure (in bytes) should correspond to the amount of RAM chips you've installed.

Other diagnostics tests can be performed at this time, or you can test the computer by running your favorite software. The IBM Diagnostics disk works with some clones, but not all. Be sure that your computer is properly configured before you run the IBM test. The SI (System Information) program that accompanies the Norton Utilities provides useful information about your computer. ■

DAWNS 8086-1 (3/93)
XT 4.7 to 10 MHz

Rebuilding Without a Hitch

Here's how to give your old IBM PC, XT, or compatible the power of an AT with high density floppy drives, an IDE hard disk and VGA display.

By Hal Glatzer

Many of the original IBM PCs and (XT) clones are still in use. Their 360K floppy disk drives and Intel 8088 processor chip continue to perform well, even after a decade. But today's computers typically come with a hard disk drive, and a 1.2Mb 5 1/4-inch or 1.44Mb 3 1/2-inch floppy drive too.

Users turn to newer computers to gain the extra-capacity floppies, and the large, fast hard disk drive (HDD); many new programs work best with a VGA color monitor. But, now these components can be easily added to a PC. The key to this upgrade is using the new 8-bit IDE hard disk controller card, and 8-bit high density floppy disk controller designed for IBM PCs, XTs and compatibles.

Prior to the introduction of these cards, upgrading an older PC and XT with a fast, inexpensive large capacity hard disk along with two high density floppy disk drives was a bothersome chore that would tax the capabilities of even a user experienced with upgrading components. (More about the reasons why later.)

Now, when you're done your old XT will function about as well as a new AT. Of course, the AT will run faster. If processing speed isn't limiting the user's progress, then these upgrades are cost-effective. What may not make sense, economically, is to replace the XTs central processor unit (CPU) and its printed circuit board (motherboard) with those of an AT (the faster Intel 286 chip).

Take It One Step at a Time

Each upgrade described here (the new floppy drives, the HDD, and the VGA) can be accomplished separately. The user can upgrade with just as much hardware as needed, or as far as the budget allows. The procedures are simple, requiring only a screwdriver.

According to Anthony Castle, president of Backup Support Systems, Inc., a Value Added Reseller (VAR) whose company deals with upgrading issues on a daily basis for companies with large installed bases of microcomputers, "All it takes is a little sophistication and a whole lot of logic."

In this article, we'll show you step-by-step how to install new highdensity, 1.44Mb and 1.2Mb floppy drives, a high speed, high capacity hard disk, and controller, a new VGA monitor and board, and even a newer higher capacity power supply to support all of the more powerful add-ons. These components will need a power supply with a minimum of 150 watts output.

PROCEDURE:

(Please read the following steps at least once through before you start to disassemble and reassemble your system.)

Removing the Double Density Floppy Drives

Step 1 Set the computer on a table large enough to hold all the upgrade components. (A flashlight isn't necessary, but have good overhead or desktop illumination.) Unplug the power cord from the wall socket and from the computer. Remove the cover from the PC. If static electricity is a problem at your site, especially if you are working in a carpeted room, spray the floor or rug with a store-bought anti-static spray and discharge the static build up in your body by touching something metal.

Step 2 Ordinarily, combo controller cards feature connectors for two floppy drives and two hard disk drives. This isn't the case with the new 8-bit controller cards for IDE hard disks and high density floppies. You will need a

What You'll Need

Tools:

- Standard flat or slot-head screwdriver.
- Extra-thin flat or slot-head screwdriver.

Supplies:

- 1.2Mb 5 1/4-inch Floppy Disk Drive (approx. $65).
- 1.44Mb 3 1/2-inch Floppy Disk Drive with Mounting Kit (approx. $70).
- 44Mb (3 1/2-inch) Hard Disk Drive (HDD) with Mounting Kit (approx. $175).
- Special for PCs and XTs Controller Card for floppy disk drives ($25).
- Special for PCs and XTs Controller Card for hard disk drive ($50).
- Face Plate for drive bay in which HDD will be mounted ($20).
- 150 Watt power supply ($70).
- VGA monitor ($350).
- Color VGA card (8-bit, or 16-bit with "auto-sensing") ($100).
- MS-DOS, version 5.0 ($70).
- (Optional: AT-style keyboard, AT/XT switchable, with function key row on top).

Sources:

To order a Silicon Valley IDE Hard Disk Drive Adapter, part number P50/8-bit with BIOS — $49, call, write or FAX:
Advanced Computer Products, Inc.
1310 E. Edinger
Santa Ana, CA 92705
FAX: (714) 558-1603
Sales: (714) 558-8813
Customer Service: (714) 558-1356
Toll Free: 1-800-FONE-ACP

To order a DTK High Density Floppy Disk Controller, part number DTK P11-151B, 1.2Mb/1.44Mb Controller — $24
PC Discount Center
Glenview, IL 60025
Order Only: 1-800-245-7454
Tech Info: (708) 390-7450
FAX Order: (708) 390-6353

All components can be purchased either from mail order suppliers, (See above or Street Price Guide in this issue.), service and support companies such as Backup Support Systems, or even at retail from full-service computer stores.

separate card for each.

Locate the long printed circuit board (called the floppy controller card) which is set vertically in its slot; it has a gray ribbon cable connected (daisy-chained) to both floppy disk drives. Disconnect the ribbon cable from each floppy. Remove the power connector from both drives—it's a plastic connector, usually white with four colored wires that run from the power supply to the drives. This disables the drives. Remove the drives from their bays by unscrewing the screws on the left and right sides of each drive.

Note: If you have an original IBM PC, not a clone, the bottom screw on the left full-height floppy disk drive (left as you face the front of the system) will be difficult to remove because it's blocked by the audio speaker. Either get a very short-handled screw driver or remove the speaker from its fragile plastic retaining clips. Once the screws are removed slide the drives out, forward, through the front face of the machine.

Step 3 Remove the floppy controller card from its slot by unscrewing its retaining bracket at the back of the system and then lifting the card—firmly—straight up. Slide the 34-pin ribbon cableconnector gently off the card. The pins bend easily and can even break off so be careful!

Step 4 Locate the power supply: It's the large, square, enclosed component that contains the on/off switch. Disconnect the electrical power connectors from the floppy disk drives if you haven't already done so (Step 2). Disconnect the electrical power connector from the "motherboard" (the large, flat printed circuit board into which all the other boards are plugged). This connector will almost always be white, and will be identified by P8 and P9 printed on it.

NOTE: Write down the orientation of the power connector to the motherboard (i.e., which side the P8 and the P9 face). If you think you can remember the orientation, you're wrong. Write it down!

When installing the connector from the new power supply, orient that connector in the original way. Occasionally, tiny plastic bumps, six on each connector (Cables P8 and P9) coming from the power supply and connectiong to the motherboard may interfere with the attachment of the new connector. Don't be alarmed! These may be removed with a small knife or razor blade.

Installing the New Power Supply

Step 5 Unscrew and remove the old power supply. This is a simple step with four screws holding it in place at the back of the unit. Before you install the new power supply, police the area for any debris, such as an old screw, which might interfere with the new unit. Now pull the power supply flush with the back wall of the computer and screw it in place.

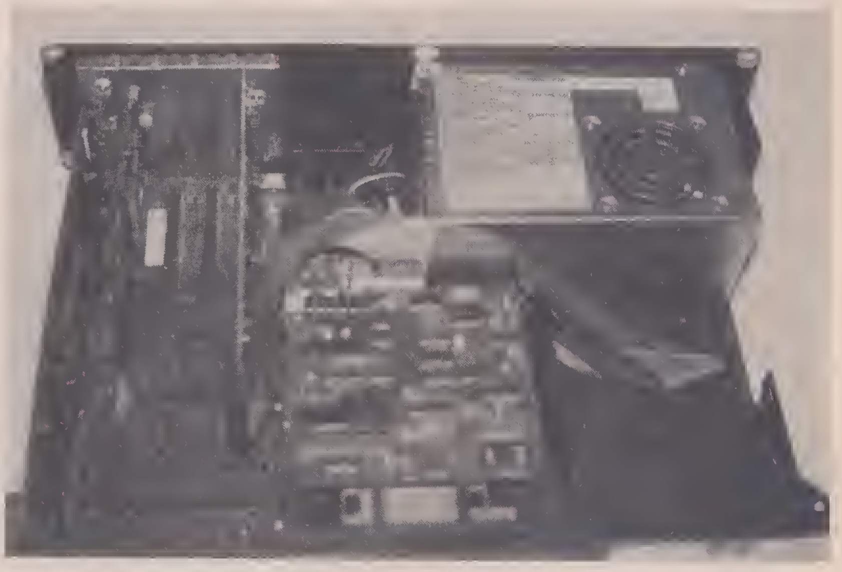
Installing the High Density Floppies

Step 6 Installing the new drives. Modern 3 1/2-inch and 5 1/4-inch drives are smaller than their original counterparts, nearly half the height. They are known as "half-height" drives. Both of them will fit together into one 5 1/4-inch drive bay. (The hard disk drive will fit in the second bay.) The 3 1/2-inch drive will require a new bracket (mounting kit) to fill up the larger 5 1/4-inch opening left by the smaller 3 1/2-inch drive. The bracket looks like a metal picture frame. (See Photo above.) Be sure to request this mounting kit when you purchase the drive. Mount the 3 1/2-inch drive into its kit (bracket).

NOTE: Beneath each floppy drive is a fly wheel. Before installation, check to see that it's unobstructed and spins freely.

Now, mount the drive with its frame in one of the 5 1/4-inch slots. Mount the 5 1/4-inch drive into the second slot. It doesn't matter which drive goes on the top or bottom, although by convention, the drive that is designated the "A>" drive is the one on top. Most people designate the 5 1/4-inch drive the A drive.

Step 7 Install the new controller card in the slot from which the old one was removed. There's only one way in which it can go; line it up with the guide at the front of the system and the bracket at the rear, then insert it in the slot so the mounting bracket faces the rear of the computer. Push the card down firmly; screw the bracket in place.



Looking down on the computer (cover removed). Step 1: Locate the large printed circuit board called the floppy controller card. Above, card nearest the floppy disk drive.

NOTE: The earliest PCs had only 256K of main memory (RAM); practically every PC still in use, however, has had its RAM expanded to 640K to take advantage of new software. If this has not been done, purchase a RAM card (with RAM) and install it exactly the same way that the drive controller or VGA cards are installed; it will come with a floppy disk which, when run, tells the computer how to configure itself for the new RAM. (Memory prices continue to fall and currently a memory card with 512K will cost about $125 to $150.)

Step 8 Connect the ribbon cable to the new controller card. Every ribbon cable has a colored stripe (usually red or blue). On the side of the mounting on the controller card where it connects, there will be either a 0 or a 1 printed on the card. When correctly oriented, the colored stripe of the ribbon cable connector is next to that 0 or 1.

Step 9 Connect the ribbon cable and the power connectors to the disk drives. The 3 1/2-inch drive mounting kit will include adapters for the controller ribbon and power connections. The new 5 1/4-inch drive will use the existing connectors.

NOTE: At this point, it's a good idea to test the drives before you go any further. Slide on the cover, connect the power cord at both ends, reconnect the monitor, put a new DOS diskette into the A> drive, and switch on the computer. Wait for DOS to run its memory test. A message will also flash briefly on the screen, identifying and acknowledging the new controller chip. On each drive, the "in-use" light will come on, signifying that the computer is "reading" or attempting to read from that drive. (Some controller cards also include a chip that presents a menu on screen, asking the user to identify the new drives; if this occurs, follow the instructions.)

Says Castle, "If the drives don't work, switch off the computer; check that the power connectors to the drives are tight, and that the ribbon connector isn't installed backwards."

Step 10 Switch off the computer; disconnect the power cord at both ends; and remove the cover. The hard disk drive is installed in the second bay in the same way as the floppy disk drives were installed in thefirst bay. Connect the HDD to its mounting bracket, slide the drive and bracket into the open drive bay, and attach with screws. The new "face plate" helps keep dust out. Mount it to the exterior (front) of the bay.

Step 11 For the HDD controller card, select an empty slot as close as possible to the computer's power supply . Unscrew one of the plates from the inside back of the computer that protects the unused slots from dust. (It's no longer needed). Insert the HDD controller card as you did the others into the slot; press down firmly, and screw the bracket into the place where the plate was.

Step 12 The HDD controller card will include a ribbon cable for the HDD. As with the floppy disk drive ribbon cable, make the connection so that the colored stripe aligns with the printed 0 or 1 on the card. Then connect the cable to the drive, aligning the colored stripe so that side of the ribbon faces the power connector on the drive. There will be an additional (previously unused) power supply connector in the computer; connect this to the drive.

WARNING—Only the new 8-bit IDE drives and controllers are compatible with an older XT system. The original PC BIOS won't recognize an IDE drive. The new 8-bit cards contain their own BIOS which overrides the original PC BIOS. (In a recent issue of PC Magazine, the editors warned of using an IDE controller in an XT system. The editors most likely were not aware of the newer 8-bit IDE controller cards. However, some end users are reporting problems in non-IBM systmes using the 8-bit floppy drive controller. In some cases the 1.44Mb floppy drive will operate only as a double density, 720Kb drive. There have been no problem reported with the 1.2Mb floppy or controller.

Three and one-half-inch floppy disk drive placed in the 5 1/4-inch mounting kit.

Step 13 Test the new configuration. Close the cover; connect the power cord at both ends; insert the new DOS diskette in the A> drive, and switch on the power. DOS will now recognize the HDD and present a menu for "formatting" the drive and for maximizing its potential. Follow these instructions. Almost always, the user will want the computer to "boot" from the HDD. Follow those instructions as well. All IDE drives have been low level formatted. All you'll have to do is use DOS to format and partition the drive, using FDisk and Format commands.

Step 14 To install the VGA card, switch off the computer, disconnect the power cord at both ends, remove the cover, and locate the printed circuit card that controls the monitor. (Typically, this will be mounted farthest from the power supply.) At the rear of the computer, this card terminates with the connector for the monitor (and sometimes the "parallel" printer port as well). If you haven't already done so, unscrewthe monitor cable, on the outside back of the PC, from the original card. This may require the use of an extra-thin screwdriver.

Step 15 Unscrew the bracket securing the monitor card to the back of the computer and firmly lift the card out. Install the VGA card in the same slot; screw the bracket down. Connect the cable from the new VGA monitor to the monitor connection at the back of the computer. (The original monitor cable won't fit the new VGA connector.)

NOTE: A 16-bit auto-sensing VGA card is larger and slightly more expensive than an 8-bit VGA card. While there is no advantage to a 16-bit video card in an 8-bit PC, it offers a future upgrade capability if the central processor is later upgraded to Intel 80386 or i486.

Step 16 If you have a monochrome monitor, locate the two banks of DIP switches on the motherboard. They are black or silver components, about one inch long, with nine numbered two-position switches on it. Identify the switch number 5 on the bank closest to the center of the motherboard and switch it over (reverse it).

Step 17 Close and screw down the cover; reconnect the power cord at both ends. Switch on the computer and allow it to "boot" from the HDD. The new 5 1/4-inch drive should be able to read program and data diskettes that were used in the original 5 1/4-inch drive, although some early PC programs may not make the transition. Software or versions published in the past two or three years—the majority of what's in use today—should work acceptably. Format new diskettes in the new drives, and copy all necessary programs and data to them. If important programs can be more efficiently used with an AT-style keyboard, replace the old PC-style keyboard with it.

Help Is Available

Backup Support System's, Inc., 419 Park Ave. So., New York, NY 10016, recently completed all of the steps outlined in this article for a major New York City hospital and is willing to help any PC Upgrade reader who is having difficulties. Call 800-SAY-SUPP ("say support").

"As the technology advances," says Castle, "the upgrade process gets easier and easier; even now, there's no reason why all PC users can't do this." ■

Best for 286

Pane-Less Alternatives

For Those Who Don't Do Windows

Boost your XT or AT's functionality with some amazingly simple software and peripheral upgrades—for as little as $500. Who knows? Maybe it's curtains for Windows!

by Ron Bel Bruno

As personal computers get faster and more graphical, some PC daydreams turn to major real-life upgrades: Triple-digit hard drive capacities, multi-megabyte RAM, and even motherboard upgrades are the stuff on which such dreams are made.

Then there are the rest of us. We don't run behemoth spreadsheets, 5,000-record databases, or high-end desktop publishing programs; Speed and storage capacity are not crucial issues. Those considerations take a back seat to features such as a common user interface among applications, display quality, mouse support, low-cost, easy-to-use communications features, and the varkEhez applications you can fit on one 20MB to 40MB hard drive.

Consider your investment

The performance issues considered, there's yet another reason not to banish your PC to doorstop duty—your original investment. In today's fiercely competitive PC market, you can pick up a complete 486 desktop system for as little as $2,500—this may be as much (if not less) than what you paid for your AT clone in 1987. If you're writing off your system as a business expense, this may not ruffle you at all. But if you're one of the millions of home users out there using an XT or AT, you'd probably like to maximize that four-digit outlay for as long as you reasonably can.

So just how much is that potential doorstop worth these days? IBM ATs and their clones still have significant value on the used market, while XTs have lost much of their appeal. The American Computer Exchange(1-800-786-0717), based in Atlanta, and the Boston Computer Exchange (617-542-4414), publish a weekly price index of used models sold on their respective exchanges. A sampling of recent prices included an IBM AT with an average sale price of $750 on the American Exchange, and $700 on the Boston Exchange. (System prices quoted include monochrome monitors.)

Clearly, there is still a significant value in XT/AT systems. According to John Hastings, president of the American Exchange, about 20 percent of the Exchange's transactions are ATs (one-third of all their IBM systems sales); 10 percent are XT sales.

Additionally, the AT-level system will likely be a presence on the new-system market for at least the next three years. DataQuest, a SanJose-based market analysis organization, predicts that vendors will sell as many as 1.4 million AT clones in calendar year 1995. Though this is a fraction of the 5.7 million units sold in 1990, it signals one crucial message to XT and AT users considering an upgrade: "You are not alone;

Your software will be supported."

So you're still envious of Windows-based systems? Get over it. If you're satisfied with your XT or AT's overall performance, you can create a graphics-based system for as little as $500 (see accompanying chart) with components purchased economically from mail-order vendors. Our suggested package of software and peripherals is centered around a revamped operating system and a new display subsystem. Rounding out the upgrade are mouse support and a modem.

Overcome the DOS Conundrum

Most XT and AT users have relied upon DOS 3.1, 3.2, or 3.3 as long as they've owned their computers, and with good reason; it's a reliable, yet increasingly outdated operating environment. But for quite awhile now, several forces have been gradually but swiftly chipping away at this piece of software bedrock.

First DOS 4.0, then the more recent 5.0, finally brought a DOS shell to the lagging operating system. Then Windows, the cultish task-switching graphical environment, was released in Version 3.0—an upgrade which removed the cult status and brought the interface to the forefront of the PC applications environment. The stage was set for the graphical revolution.

Unfortunately for many, the stage was also set for big- time upgrade demands. After all, how could you avoid it? Windows needs a minimum of 2MB of RAM, EGA graphics, and tkMB of hard drive space just to run—and that will hardly provide optimal performance . Such taxing requirements would render even the most advanced AT inadequate.

Time to rethink the wisdom of a Windows upgrade? For many users, the answer is an emphatic "Yes." While DOS 5.0 and Windows are fine pieces of software, they aren't the only ones of their kind you can use. In fact, for XT and AT users specifically, they may not be the best combination at all.

Digital Research
DR DOS 6.0
Operating System for Personal Computers
Unleash the power of your PC with the most advanced, powerful and feature-rich DOS.

DR DOS 6.0 is a complete operating system designed to replace MS-DOS in any IBM or compatible PC, from an 8088 to an 80486. Developed by Digital Research, DR DOS rivals conventional DOS in three crucial areas: Memory management, task switching, and file/disk management utilities. Though its memory management features best benefit systems already equipped with more than the conventional 640K of RAM memory, its otherfeatures will prove to be a boon to even the most bare-bones of PCs.

Perhaps the most useful feature of this program is within its DiskMAX feature roster. It includes dynamic file compression, which effectively doubles your hard drive's capacity. Disk defragmentation (in which sectors scattered randomly over your hard drive are collected together to optimize performance) and disk caching work together to breath new life into your tired old drive.

If your system memory has been expanded above 640K, DR DOS 6.0 provides swapping and allocation schemes MS-DOS 5.0 can't offer. For example, on an IBM AT equipped with tkMB of RAM, DOS 5.0 would allocate only 555K of conventional memory for applications. This is because MS-DOS, unlike DR DOS, does not place the cache, display, mouse, VDISK, and Network drivers into upper memory. Because of DR DOS's better use of upper memory, it yields 628K of conventional RAM memory for applications usage.

This alternative operating system also provides you with a host of luxuries you didn't think possible on an XT or an AT system. Its Undelete feature second-guesses your file-deleting decisions by saving the nixed files- -even after writing to the disk many times (a highly useful feature also found on the Norton Desktop for Windows). There are also several password options, a command-line history function, and a full-screen editor for easy alteration of command files.

Now Take Windows to Task

While all of this onto itself may be enough to discard your current operating system, yet another aspect of DR DOS 6.0—its task-switching attribute—cinches its position as the catalyst of your system upgrade. Digital Research has joined forces with GeoWorks Software, the makers of the GeoWorks Ensemble graphical user interface, in a cooperative alliance that has resulted in the maximized compatibility of these two programs. The resulting environment, for those familiar with Windows, is not unlike Windows working with Norton Desktop—less a few megabytes of RAM and drive space, that is.

GeoWorks Ensemble has been dubbed by many "as Windows lite," and that's no surprise. It is thus far the most versatile and adaptable Windows alternative. This lean, functional suite of applications packs the virtues of Windows—icon-driven navigation, easy file management menus, and compatibility of commands among applications—without its bugaboos—namely behemoth memory and processor requirements and high-resolution display capabilities.

In fact, GeoWorks operates on any system from an original IBM PC to a 486/50. (Though quite frankly, my tests on a 6MHz PC with a CGA monitor didn't do the program justice in either performance nor appearance.) The full GeoWorks roster includes a word processor, painting and drawing program, communications module, and several desktop accessories.

GeoWorks Writer, a graphical WYSIWYG word processor featuring typeface selection and sizing, multiple column formats, graphics importing, and full-page preview—functions only recently granted standard- feature status on most word processing programs. Additionally, it's fully compatible with dot-matrix printers.

GeoWorks Designer, a WYSIWYG drawing and design program, succeeds Windows Paint in this applications lineup. It includes eight drawing tools, 150 pieces of clip art, and 70 templates for cards, banners, posters, business forms, presentations, and newsletters. Templates and clip art can be modified to suit your particular project needs.

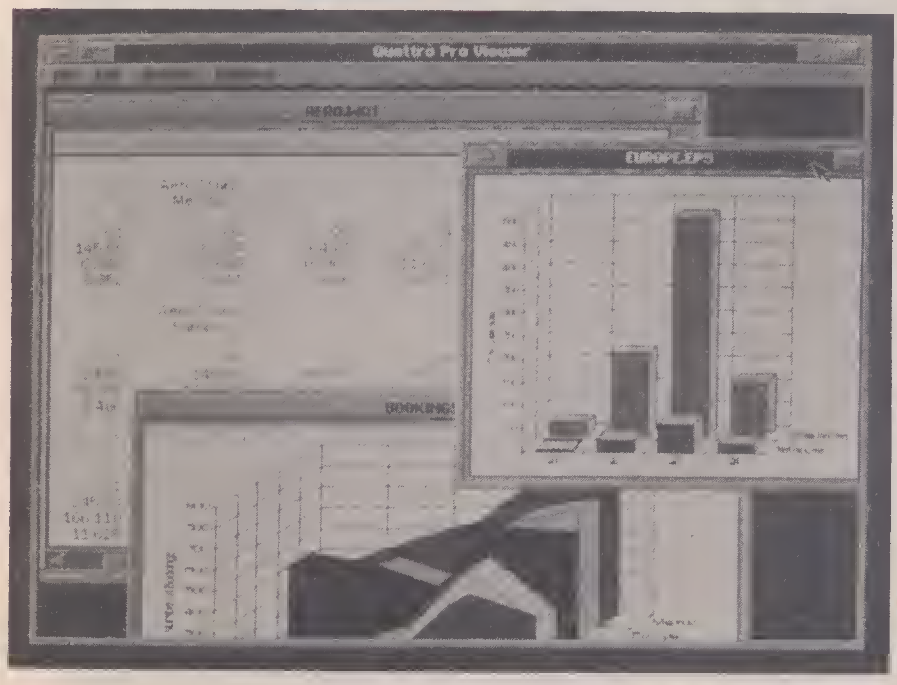
Even Better w/ upgrade to Pro + Quattro Pro —

Windows' Program Manager is usurped by GeoWorks Desktop. In addition to its DOS shell, Desktop also includes a notepad, calculator, and two games—Tetris and Solitaire. It surpasses the Program Manager in versatility with a calendar and an address/phone book. There's even a software interface for accessing America OnLine, an interactive telecommunications service.

GeoWorks recently released the Writer, Designer, and Desktop modules in separate packages, so users can pick and choose only those areas they need or want the most. Additionally, the company will also offer a version of GeoWorks with a special version of Borland's Quattro Pro—the first major application to be released for the GeoWorks environment. At least one other third-party spreadsheet, and several desktop publishing utilities, are also under development.

According to Lee Ellermeier, of GeoWorks, XT and AT users are forming a large contingent of GeoWorks users, and many of them are using it with DR DOS 6.0: "GeoWorks lets you upgrade your capabilities without a hardware upgrade. It gives you a much less expensive fix."

Indeed it does, though if your system is configured as most XTs and ATs are, you may need to do at



least a couple of hardware upgrades for optimum performance and value. Following are some options:

Give Your Eyes a Break

You'll need enhanced resolution to make any graphical upgrade a worthwhile venture. And, unless you're willing to make some compromises in this purchase, il ban be the most draining expenditure of your upgrade. An 800 by 600 Super VGA monitor with compati ble card, for example, cancost as much as $600—about half the cost of a brand new 386SX system.

However, there are alternatives. The direct channel is home to dozens of PC vendors offering exceptional values on higher resolution monitors at a reasonable cost. If you're currently using a monochrome or CGA monitor and want to save your eyesight, you c an upgrade to a VGA page-white monochrome display system for about $200—including the video card. (Don't even consider buying an EGA monitor, no matter how attractively priced it is. VGA, now the de facto standard in PC displays comes in enough versions as it is.)

A color upgrade requires a higher investment. For as little as $300, you can buy a 640-by-480-pixel video card and display. While it's hardly the highest resolution available, it can run virtually any software you'll be able to boot on your system. And, s hould you decide to buy a new CPU in the future, you can use the same monitor with no problem. Also, the compatibility between 640 by 480 video cards and 640-by-480-pixel monitors is well established, thus removing the potential for compatibility problems, though for best results try to find a package deal like that featured in the accompanying chart.

A BARE-BONES UPGRADE ALTERNATIVE

Take this upgrade path and you'll gain graphical functionality at a minimal cost. When you're ready to sell your system, these add-ons will enhance its attractiveness.

Category	Make/Model	Vendor	Cost
VGA Page-white Monitor and Video card	Harmony 14-inch Page-white VGA monitor and compatible card	Harmony Computer 1801 Flatbush Ave. Brooklyn, NY 11210 (800) 441-1144 (718) 692-3232	$129/$69
2400 bps Internal Modem	Powerplus 2400 bps internal modem	Powerplus 4932 Sharp St. Dallas, TX 75247 (800) 878-5530; (214) 631-2550	$69
I/O Board	USA Electronics AT I/O Card w/serial parallel, game ports (XT serial-only is $17.75)	USA Electronics, Inc. 9090 N. Stemmons Freeway Dallas, TX 75247 (800) 332-8434; (214) 631-7800	$29.75 ($17.75 for XT)
Two-button Mouse	PowerPlus mouse	Powerplus 4932 Sharp St. Dallas, TX 75247 (800) 878-5530; (214) 631-2550	$14
Graphical User Interface	GeoWorks' Ensemble	Compuclassics PO Box 10598 Canoga Park, CA 91309 (800) 733-3888; (818) 347-7500	$125
Operating System	Digital Research/ DR DOS 6.0		$69
			Total: $504.75*

**These totals do not reflect possible shipping or credit card surcharges, and are subject to change.*

BUYING WITH AN EYE TOWARDS THE FUTURE

Though you're content with your system for the moment, next year may bring a change of mind. This upgrade solution comprises components you may want to take along with you when you decide to upgrade your CPU.

Category	Make/Model	Vendor	Cost
VGA Color Display/ Video Card	A-Plus 14-inch, 640-by-480 VGA monitor with compatible 256K video card	A-Plus Computer Inc. 398 Lemon Creek Dr., Unit H Walnut, CA 91789 (800) 443-5373; (714) 594-1112	$295
2400 bps External Modem	Powerplus 2400 bps External Modem	Powerplus 4932 Sharp St. Dallas, TX 75247 (800) 878-5530; (214) 631-2550	$89
I/O Board	USA Electronics AT I/O Card w/serial parallel, game ports	USA Electronics, Inc. 9090 N. Stemmons Freeway Dallas, TX 75247 (800) 332-8434; (214) 631-7800	$29.75 ($17.75 for XT card)
Two-button Mouse	Microsoft Mouse	Arlington Computer 1970 Carboy Mt. Prospect, IL 60056 (800) 548-5105; (708) 228-6333	$89
Graphical User Interface	GeoWorks' Ensemble	Compuclassics PO Box 10598 Canoga Park, CA 91309 (800) 733-3888	$125
Operating System	Digital Research DR DOS 6.0		$69
			Total: $696.75*

**These totals do not reflect possible shipping or credit card surcharges, and are subject to change.*

Hands off the Keyboard

No graphical interface upgrade makes sense without a mouse, which have quickly become a high-volume commodity item. Microsoft-compatible mice can be had for as little as $20, though you might want to consider buying "the real thing" for total compatibility and peace of mind—and several dollars more. First, determine what kind of mouse you need. A serial mouse, which requires a serial port, is the most prevalent. If you're XT doesn't have a serial card or available serial port, you can buy a serial card with two or three ports for as little as $30 (see chart).

You can run GeoWorks without a mouse, but you'd be selling yourself short in the process. Opt for the extra expenditure and give yourself the flexibility you need to run other graphical, menu-driven applications and games.

Expand Your (Communications) Horizons

Once you're equipped with graphics, mouse support, and a Windowed environment, you'll want to round out your capabilities with a modem. In fact, GeoWorks includes not only a fully featured communications application, but also a software interface to America On-Line a national communications service similar to the

IBM/Sears Prodigy system.

Modems are another high-volume item which are now very inexpensive. You can get a feature-laden, 2400 bps Hayes-compatible (important!) modem for as little as $69 by mail. Before making a buying decision, however, you'll have to decide whether you want an external or internal unit.

Internal modems offer several advantages. They take up no desk space, and are not as succeptable to being banged around, dropped, or disconnected. However, if you're the type of user that needs to see the "send" and "receive" lights for visual reassurance , or simply doesn't like to install boards, you may want to opt for an external unit. Prices in most cases are similar if not identical.

One modem-buying caveat. With speeds now as high as 9600 bps, it doesn't make sense to get anything less than a 2400 bps modem--the current standard for most communications services. The astoundingly low cost of a 1200 bps modem (sometimes as low as $20) might sway you otherwise, but the extra $30 to $50 you may spend will insure you less nervous fidgeting at your keyboard and compatibility with other computer's data transmission speeds far longer into the future.

If a modem comes with bundled communications software, by all means try it out. You may find, as is the case with Windows Terminal program versus stand-alone communications applications, that it provides faster operation than GeoWorks' built-in program. Also, if you're logging into BBS's you'll find that most people use one of a small handful of applications, and can provide you with endless tips and tricks to maximize your communication performance.

Always Look Ahead

Even the most novice of PC users can benefit from buying software and peripherals with an eye to the future. In this case, that means considering what type of system you will buy next. In this upgrade package, all these items are compatible with a 386SX, DX, or, for that matter, even a 486 (though anyone buying a 486 probably has little use for a 640 by 480-pixel monitor).

Consider this. If you decide in one year to purchase a new system, you'll already have a display subsystem, modem, mouse, and operating software accounted for. (However, if you plan to copy any software to your new system, you'll need to delete it from the old one to stay on the right side of the copyright law and of your conscience.) This will undoubtedly save you at least a couple hundred dollars off your total new-system bill. ■

Taking the Mystery Out of Mail-Order

There are myriad advantages to buying components via mail order forthis or any other upgrade. Not only do you save money, but you can also do most of your comparison shopping by flipping through the pages of a magazine and calling a few 800 numbers.

Still, despite this relative ease, you'll need to ask some questions to avoid becoming a mail-order ripoff statistics. Keep the following list in front of you while placing an order:

What is your payment policy?

"Cash only" usually means that a check is ok. However, that may also mean a certified or a cashier's check, as opposed to a personal check. On personal checks, most companies have a standard waiting period to ensure that the check clears—sometimes as long as 21 days— probably longer than you're willing to wait for your order.

Do you have a credit-card surcharge?

Credit cards are the easiest road to a quick delivery, and are sometimes subject to an additional fee—3 to 5 percent in some cases. Another aspect of credit-card purchasing to consider: A more aggressive company will charge your card as soon as the order is placed. In a perfect mail-order world, that charge is made upon shipment, and you also won't pay a surcharge.

What's your standard shipping method, and how much does it cost? Are shipments insured?

Though many companies ship via UPS at no extra cost, others charge a fee or even the total cost. If you're in a real hurry and don't mind the expense, most companies will also ship via overnight or second-day service.

Is the item in stock? If not, when will it be? When can I expect to receive it?

continues on next page.

Unless you get a commitment on the date of delivery, you have no recourse should it be delayed unreasonably.

What is your complete return policy?

Before you give that credit card number or send a check, make sure you know if there is a money-back guarantee, and if so, how long is it? (Though a majority are 30 days, some can be as little as seven days or as long as 60 days). Does the company accept returned opened software? Is there a restocking fee? (A restocking fee is a percentage of the total purchase price that is held by the vendor when a product is returned for reasons other than malfunctioning or because it's defective.)

Do you offer technical support or service?

Though some of the companies listed here are wholesalers with little!n the way of technical support staffs or service facilities, manymail-order vendors have some form of telephone-based technical support.

Should something go wrong with your order and the vendor won't resolve the problem to your satisfaction, there are alternatives. First, write—don't call the company. In all correspondence, state the order number, name of your salesperson, date of transaction, and a summary of the problem. Avoid getting offensive or emotional—that helps maintain your credibility later in case a third party intervenes.

If your letter is not acknowledged to your satisfaction, file a complaint with the Better Business Bureau for the company's locality. Also, the Mail Order Action Line of the Direct Marketing Association (6 E. 43rd St., New York, NY 10017), a private indus try council of mail-order vendors, can also help resolve a valid complaint.

Credit card customers are further protected by the Fair Credit Billing Act, which states that customers disputing goods or services with a vendor need not pay the amount due until the situation is resolved. Even if you've already paid, the act allows your credit card company to "charge back" the vendor for the disputed goods; this charge-back is then credited to your card's account.

These additional mail-order vendors typically carry the types of upgrade components mentioned in this story:

Computer Discount Warehouse 2840 Maria Northbrook, IL 60062 (800) 726-4CDW

Damark 7101 Winnetka Ave., N Minneapolis, MN 55429-0900 (800) 729-9000; (800) 788-7001

Dustin Discount Software 20969 Ventura Blvd., Ste. 13 Woodland Hills, CA 91364 (800) 274-6611; (818) 710-9174

Electrified Discounters 1066 Sherman Ave. Hamden, CT 06514 (800) 678-8585; (203) 287-1976

FastMicro 3655 LaSalle St. Phoenix, AZ 85040 (800) 821-9000; (602) 437-5700

MidWest MicroPeripherals 6910 U.S. 66 E. Fletcher, OH 45326 (800) 423-8215

Quick Electronics 10800 76th Ct. N. Largo, FL 34647 (800) 800-5500; (813) 546-9299

Ralin Wholesalers P.O. Box 450 Orchard Park, NY 14127 (800) 752-9512

SoftHard Systems 3316 Sheridan Dr. Amherst, NY 14226 (800) 999-9531; (716) 834-2125

Software Add-Ons 2 Greenwood Sq., Ste. 155 Bensalem, PA 19020 (800) 822-8088

Software Unlimited 2465 W. 12th St., Ste. 5 Tempe, AZ 85281 (800) 926-7638

Telemart 8804 N. 23rd Ave. Phoenix, AZ 85021 (800) 537-4735

Tredex 5306 Beethoven Ave. Los Angeles, CA 90066 (800) 338-0939 (213) 301-0300

U $ave 1702 W. Camelback #376 Phoenix, AZ 85015-3372 (800) 362-7640

USA Flex 135 N. Brandon Dr. Glen Ellyn, IL 60139 (800) USA-FLEX; (800) 872-3539

Under-Ware Electronics 7761 W. Kellogg Wichita, KS 67209 (800) 442-1408; (316)721-2600

Warehouse 54 2415 S. Roosevelt Tempe, AZ 85282

Post Cards From the Diagnostic Leading Edge

If you live in fear of estimates from your auto mechanic and TV repairmen here's a sure-fire way of keeping your computer repairman honest.

by Robert Hurt

Imagine this: you walk up to your computer, switch on the power and nothing happens. The screen is blank. What do you do? Reactions to this situation vary from looking for a loose power cord or monitor connection to delivering a robust slap to the side of the monitor. The more adventuresome may open the case, and wiggle some boards around. If the system failure is legitimate, however, most people will call a service technician. But there is a less expensive alternative to diagnose your computer failures, POST (Power On Self Test) cards.

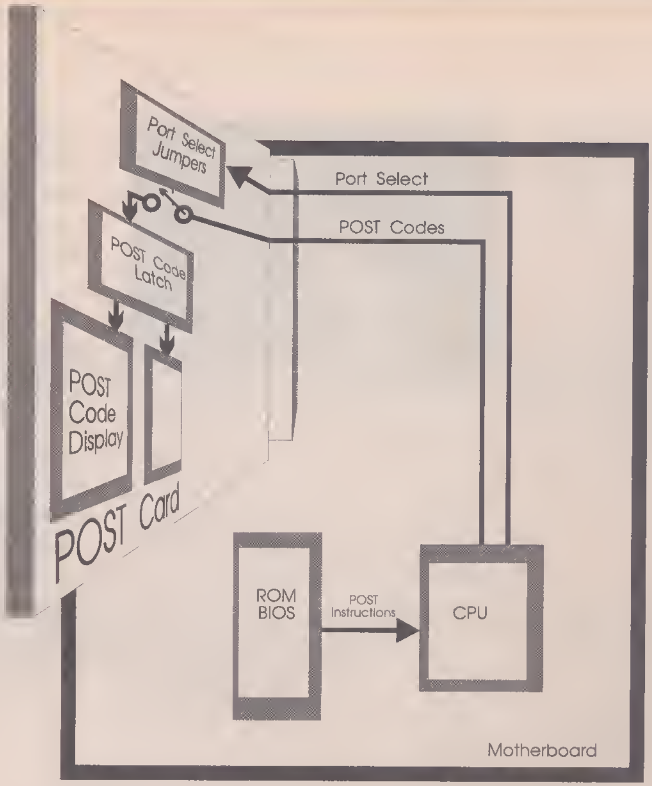
While popular diagnostic software programs like CheckIt, PC Tools and Norton Utilities let you check out a live computer, POST cards let you check out a dead one. If you've just upgraded an older PC or built a system from scratch, typically you will have forgotten to set a DIP switch or a jumper, or plugged a memory chip in backward or in the wrong location. Perhaps a wire or cable was connected improperly. A POST card catches these problems even before the system is completely put back together again. Prices for POST cards, they will fit into any available slot, vary from $59.00 to $250.

How They Work

When power is switched on to the computer, the central processing unit (CPU) reads instructions from the BIOS (Basic Input Output System) chip socketed on the motherboard. This ROM (Read Only Memory) chip contains power-on-self-tests (POSTs) and a loader program. The first thing the BIOS chip tells the CPU to do is to test various circuits in the system to make sure they work properly and to initialize them. The first circuit tested is the CPU itself. In order to monitor the progress of these tests and the initialization procedures, the POST instructions from the BIOS send a number code, referred to as a POST Code, to an output address. (More about output address in your model computer later.)

Simply put, a POST card intercepts the diagnostic code being sent to that electronic address and displays them on LEDs or a two-digit display. If the POST test were to detect a critical error it often halts the CPU, but even when it doesn't, all the user need do is look up the meaning of the code displayed on the POST card in the manual and he will know what area of the computer is defective. For example, if the BIOS chip indicates a failing bitin the memory test, the POST code sent by the BIOS will often point directly to a specific defective memory circuit. In such a case you can fix the problem yourself simply by swapping the defective RAM chip with a good one.

Weigh the cost of a single RAM chip and the cost of your POST card against calling in a service technician to find the problem. Many technicians do not own or use POST cards because they haven't caught on that widely yet, but you can call a service center and say "My POST card is showing a bad DMA controller even if you don't know what a DMA controller is!



A POST card shows Power-On Self-Test codes during system cold boot: 1) You switch power on; 2) the CPU is forced to fetch instructions from the system BIOS ROM; 3) those instructions execute a self-test; 4) for each step, the CPU sends a checkpoint or test code to the test port address; 5) if the test hangs up, the failing code is shown on the POST card display.

Using a POST Card

To use a POST card to diagnose a dead computer you must perform the following steps:

Step One. Plug it into an available expansion card slot in the computer.

There are three major kinds of plug-in slots for PC compatible computers, ISA (Industry Standard Architecture) , EISA (Extended ISA), and microchannel as found in the PS/2. Each of these kinds of computers issues POST codes. Each kind provides a different kind of expansion slot.

A POST card that plugs into an ISA slot will also plug into an EISA slot, but not vice versa. Also, most ISA POST cards will not show codes in an EISA computer. No ISA or EISA card will plug into a microchannel slot, nor vice versa.

Step Two. Switch computer power on.

All POST card have power indicators, usually four LEDs to show whether the voltage is at the proper level for the logic circuits, disk drive motors, serial port drivers and for old-style floppy disk controllers, analog data separator circuits. Instantly you will see if the power supply is outputting its voltages. If the power LEDs don't glow brightly, or don't come on, you have either a loose connection or a defective power supply.

Step 3. Watch the lights on the card.

The POST code display consists of either eight LEDs, on the inexpensive cards, or a two-digit numeric display. In either case, they show the codes that are issued by the system BIOS during the Power-On-Self-Test.

Step 4. Look up the failure symptoms in the Post card manual and note the related cause.

The broad variety of BIOSes installed in the estimated 30 million PCs in the world send POST codes to a variety of output addresses (ports). The IBM PC, XT, AT PS/2 model 25 and 30, Olivetti, Compaq, EISA, and microchannel computers all send POST codes to different output addresses. The most popular address is port 80, the one used in the AT. However, that does little good if you have one of the systems mentioned above. If you are unsure of the address location for POST codes sent by your particular BIOS or if you have a variety of systems, the safest bet is to get a card that monitors all of the addresses or ports used.

Step 5. Look up the failure symptoms in the POST card's manual and note the related cause.

It does not do too much good to display POST codes if you don't know what they mean. Your manual absolutely must list POST code meanings for all the popular BIOSes, and as many as possible of the unpopular ones.

Unfortunately, nothing can be done about computer companies that don't release their codes. BIOS manufacturer ERSO/DTK, for example, has refused to put any POST codes at all in their BIOS so it is impossible to rely on them for troubleshooting.

Some companies provide diagnostic software on ROM chips that replace the BIOS on the motherboard for testing purposes only. Although these are intended for professional technicians, they do not depend on system BIOS for any diagnostics.

Some BIOS chips sound an intricate and informative pattern of beeps to give even more failure information. For example, AMI BIOS emits up to 10 beeps; Phoenix BIOS emits a separate beep pattern for each possible POST error.

You must be sure that the documentation for your motherboard includes a clear description of the beep code meanings. Unfortunately, most motherboard manuals, let alone system manuals from major manufacturers, contain sufficient beep and POST code definitions.

Step 6. Fix the problem or call a service professional.

Many users don't want to fix a complicated computer problem, even if they know what it is. They would prefer to call in a professional. Even in that case, you can shorten the time it takes to find out what the problem is. Many times it can be something so trivial that you can remedy it yourself by pressing down on chips in the system that may have worked loose or by tightening a loose connector.

You can also shorten the time it takes for a technician to find the problem and reduce the danger of a hasty diagnosis. And, if in fact, you are a service professional reading about POST cards for the first time a card will relieve you of most of the tedium of endless swapping with known "good" parts.

Finally, you can keep your own curiosity satisfied. Owning and operating a computer without a POST card is a little like driving a car without engine warning lights on the dashboard. After 90 years of automobile history, no car owner would accept a dashboard without the warning lights. Perhaps after that much computer history, users will feel the same way about POST cards. In fact, some computer makers, Dell and IBM in particular, have started adding POST information to the front panels of their more expensive models. ■

Most Popular BIOS Chips

Before purchasing a POST card, determine your BIOS and ask the POST Card supplier if their manual lists the POST codes for these BIOS chips.

AMI (American Megatrends, Inc.)
Award Software
Chips & Technologies
Compaq
Eurosoft
Faraday
IBM XT, AT, PS/2
Landmark
Microid
Olivetti
Phoenix
Quadtel
EISA extensions

Post Card Suppliers

Data Depot Inc.
1710 Drew Street #5
Clearwater, FL 34615-6213
Phone: 800 275-1913; Order line: 800 275-1913
FAX 813 443-4377
Product: PocketPost, with 170-page manual, includes *PC Certify* diagnostic software, $199.

Landmark Research
703 Grand Central Street
Clearwater, FL 34616
Phone: 813 443-1331
Product: Kick-Start1, with 32-page manual, $69.

Microsystems Development
4100 Moorpark Avenue, Suite 104
San Jose, CA 95117
Phone: 408 296-4000
Product: POST CODE Master, with 21-page manual, $59

Ultra-X
2005 Delacruz Blvd. #115
Santa Clara, CA 95050
Phone: 408 988-4721
Product: QuickPOST-PC, with 30-page manual, $99

The Sound of One Board Yapping

The sounds of silence may be okay for a Zen Buddhist, but computer users have suffered in silence far too long.

by Carol S. Holzberg

A home computer wears many hats. It lets you type letters, keep household budgets and accounts, and stay organized. You can use it when you want to play your favorite electronic games or harness its power to reinforce the basic skills your children learn at school.

If you use your computer for entertainment or education, consider purchasing a sound card like Creative Lab's Sound Blaster Pro, the less powerful Sound Blaster, or Ad Lib's Ad Lib Music Synthesizer Card. These devices make your computer come alive with special audio effects that your PC's internal speaker can't produce. Without a sound card, for example, you couldn't hear music, sounds, or dialogue in Broderbund's "Kid Pix" (a whimsical talking paint program), nor could you listen to the melodious score of Interplay's Castles (an entertaining medieval "SimCity"). The nursery rhyme characters in Sierra's Mixed-Up Mother Goose would be silent, as would be the Chief of Acme's Detective Agency and the informants you meet in Broderbund's Where in the World Is Carmen Sandiego (Deluxe Edition).

More and more developers sell game and educational software with special sound effects, digitized voice, and music. Companies like LucasFilm Games, Spectrum Holobyte, Electronic Arts, Walt Disney Software, and Virgin Games (to name just a few) deliver programs with great PC audio, that you can't hear without a special card. Now that the street price of some audio boards is less than $100, listen to some sound advice and take the plunge.

While procedures for installing a sound card (or any add-in board) are very similar, this article discusses installation of a Sound Blaster Pro. The Pro is the Cadillac of today's mid-range sound boards. Not only does it put stereo sound on your desktop (Ad Lib generates only monophonic output), it gives you tools to create multimedia business presentations, complete with digitized voice, mood-setting music, and bouncy audio effects.

Pro features stereo digitized recording and playback options, stereo FM music synthesis, two FM chips providing 22 voices, 8-bit stereo DACs (Digital to Analog Converter chips), 8-bit ADCs (Analog to Digital Converter chips), MIDI and CD-ROM drive interfaces, a joystick port, and more. It comes with software that supports stereo recording, compression, and voice file editing, plus a TSR that produces speech from ASCII text. You get a MIDI Sequencer and an application that enables you to integrate Autodesk animation features with Pro sound capabilities. If you don't need or want all these features, opt for the original Sound Blaster or even an Ad Lib. To get the most out of your system, however, Sound Blaster Pro is a sound investment. It even offers support for Microsoft's Multimedia Level I Extensions to Windows.

Installation Primer

Before installing Sound Blaster Pro, take a moment to examine the board. You'll see four connectors on the back bracket. These are Line In, Microphone in, Speakers Out, and Joystick/MIDI Adaptor Plug. A diagram in the manual shows which is which, but I placed a tiny stick-on label beneath each port for instant identification. Also note the location of card "jumpers." The board is populated with several black rubber sleeves, called jumpers, which sit snugly on double lines of gold posts. You may have to move one or more of them if your computer starts behaving strangely after the Pro is installed.

Installation Tools

You won't have to purchase expensive tools to install the Sound Blaster Pro. The card plugs into any free 16-bit slot on the computer's motherboard. You'll need a Phillips screwdriver to attach the card's metal bracket to the back of your computer. You might also need a Phillips screwdriver to remove screws from your computer case. Place each screw in a cup or small plastic container as you remove it from your computer.

Radio Shack sells a Mini-Phillips Screwdriver Set (Archer 64-1962) for $4.29, containing 6 Phillips screwdrivers. You'll find that they come in handy whenever you have to install new peripheral cards. The tiniest screwdriver is perfect for changing dip switch settings. You could use the tip of a ball point pen to make changes, but it always leaves marks on the switch. If you use a lead pencil, the lead might break off in the switch, rendering it useless.

In addition to a mini-screwdriver set, I also keep a set of inexpensive surgical sutures on hand to retrieve screws that drop into the case during installation. You don't want to leave a loose screw on the motherboard at start-up because it might cause a short circuit that would damage your system. Surgical sutures function as vice grips. They can be purchased for about $2.50 at liquidation outlets. If you don't have sutures, a pair of eyebrow tweezers or stamp tongs will do, although these tools are shorter than sutures and therefore more difficult to maneuver in tight spaces.

Installation Procedure

1. Turn off power to your computer.
2. Remove the computer cover. (You might first have to remove screws attaching the cover to the computer.)
3. Touch the power supply on your computer to discharge any static electricity that may be on your body.
4. Remove the screw that holds the slot cover plate for an unused 16-bit slot. (Sound Blaster and Ad Lib cards

fit into any unused slot).

5. Lift the slot cover plate to unseat it from the computer.

6. Insert Sound Blaster Pro into the empty 16-bit slot, making sure not to touch the gold fingers at the base of the card. The fingers will enter the slot with some friction, then seat firmly. The bracket on the card should fit into the groove previously occupied by the slot cover plate.

7. Screw the Pro's card bracket to the back of the computer.

8. Connect the stereo audio output port at the back of the card to a set of speakers, headphones, or home stereo unit.

9. Adjust the card's volume control (at the back) to mid-range.

10. Replace the computer cover.

Testing the Card

Once the Sound Blaster Pro is installed and properly connected, it's time to boot the system. Creative Labs includes a diagnostic program called "TEST-SBP" to identify the basic hardware configuration of the Sound Blaster Pro and test board voice and music output. If all goes well, melodious sound will pour forth from your speakers. If there are conflicts with other adaptor cards, however, your computer might hang when you run the diagnostic test.

If your system crashes or if your Sound Blaster Pro doesn't work, don't panic quite yet. You need only modify the hardware configuration for either Sound Blaster Pro or the adaptor board that is conflicting with it. This will involve changing a card's I/O (Input/Output) address, IRQ (Interrupt Request) setting, or DMA (Direct Memory Access) channel. This may sound daunting, even frightening, but the Sound Blaster Pro's manual provides well-written instructions that, if followed, will just about guarantee success.

Troubleshooting

Adjusting hardware configuration settings for I/O Port address, Interrupt assignment, or DMA Channel requires you to reset specific jumpers, then install new software drivers (SOUND and BLASTER) to recognize configuration changes.

Creative Labs strongly suggests that youchange the settings on the conflicting add-in board. However, it may be more convenient to change jumper settings on the Sound Blaster Pro card. After all, you have documentation for the Pro card handy, and you know that your other cards worked well together before you installed the Sound Blaster Pro. If you decide to change the I/O port address on another card, remember to re-configure the I/O port address for programs that run in conjunction with that card.

Generally, IRQ and I/O conflicts are simple to fix. Change the IRQ setting first. On the Sound Blaster Pro, it's the one least likely to cause further problems.

Begin by changing the Pro's IRQ setting from IRQ7 (the default) to IRQ2 or IRQ5. When switching a jumper, keep one side attached to a post at all times. Otherwise, it's easy to misplace. If you still have problems after making IRQ changes, try modifying the Pro's default I/O port address. Simply pull the jumper from JP13 and place it on JP14. Several programs supporting Sound Blaster are set for a 220H port address (i.e., JP13), so remember to reconfigure this software as well.

My Sound Blaster Pro board installed without a hitch. I didn't have to change any settings to get the card to work. With a bit of luck—and if you follow the instructions carefully—yours should do the same, adding a whole new audio dimension to your desktop PC. ■

Product Information

Product: Sound Blaster Pro
Minimum System Requirements: 512K IBM AT 286, 386, i486, PS/2 (Model 25/30), Tandy AT and compatibles (286 and higher recommended); 16-bit free slot on the motherboard; DOS 3.0 or higher; amplified stereo speakers, headphones or home stereo set. MMPLAY software requires VGA adaptor to run. The rest of the bundled software requires EGA or better (VGA recommended).
Company: Creative Labs, Inc., distributed by Brown-Wagh Publishing, 130-D Knowles Drive, Los Gatos, CA 95030, (408)378-3838 or (800)451-0900.
Price: $299.95.

Product: Sound Blaster
Minimum System Requirements: 512K IBM PC/XT, AT, 286, 386, i486, PS/2 (Model 25/30), Tandy (except 1000EX/HX) and compatibles; DOS 2.0 or higher; any free slot in the computer; amplified stereo speakers, headphones or home stereo set; CGA, MGA, EGA, or VGA compatible graphicboard.
Company: As above.
Price: $169.95.

Product: Ad Lib Music Synthesizer Card
Minimum System Requirements: 256K IBM PC or later; CGA, EGA or later; DOS 2.0 or later; headphones, speakers, or home stereo set.
Company: Ad Lib Inc., 50 Staniford Street, Suite 800, Boston, MA 02114, (800)4[illegible]86.
Price: $119.95.

Save Hundreds of Software $ with On-Line Services

For the price of an on-line subscription you can get dozens of free programs, everything from games to graphics, word processing to spreadsheets. Plus you can access the skills of hundreds of users of all the most popular programs for free tech support.

We all know that adding a modem to your computer opens up a world of airline schedules, news-agency wires, wine and food advice and so forth. Here we are concerned with only one aspect of these telephonic offerings. Several on-line services are home to electronic bulletin boards and users' forums that give you instant access to software, upgrades, fixes, enhancements, information and advice both direct from the manufacturer and from other users (many of whom display a level of know-how that puts them in the expert category).

There are many options (Prodigy, America On-Line and other nationwide services all have tech support forums), but the one we find ourselves turning to most frequently is CompuServe. For one thing, it has a large base of customers, which makes for a sizable group of people who log on regularly and who are most willing to put in their two cents' worth on any problem you can throw at them. Among them are numerous hackers and programmers who offer simple—or full-featured—software either for free or for a small shareware fee (payable, on the honor system, only when you have used the program for a while and have decided it's worth the money). For another, on the tech support front it covers the ground of hardware manufacturers and software publishers more comprehensively than competing services: Well over 200 companies are represented in tech support and downloadable software forums. The list appended to this article (complete as of December 1991) shows the breadth of coverage.

As to depth of coverage, that depends on the company, the forum administrator (known as the sysop, for SYStem OPerator; a forum can have several of these) and the other users. An active forum with on-the-ball sysops and a band of expert users who check in regularly can provide amazing results. Arcane problems the company never thought of can be solved in a trice if your message is read by a user 1,500 miles away who just happens to have experienced the same difficulty and who has spent hours working out how to overcome it.

Additionally, such a forum is not bound to the company line. Let's face it: manufacturers have been known to conceal defects and bugs by creating a smoke screen of blame-shifting. "It isn't our modem," they'll tell you, "It's your communications software." Or your computer's serial port. Or your local phone lines. "It isn't our software, it's the version of DOS you're using." Or your TSRs. Or your computer's serial port. With dozens (or hundreds—or thousands) of experienced users on the line, it is harder for a company to getaway with that kind of fob-off. In an active forum, then, you may get more imaginative—and sometimes straighter—information.

Of course, if the forum is out in the electronic backwoods, representing a product with a small or unsophisticated user base, few other members of the public may be frequenting it. (If it is really small, even the sysop may drop in only on occasion.) That doesn't matter if you are there to download a software upgrade, but it can be a problem if you have a question that needs an answer. In that event, you may find yourself waiting days for a reply.

Free Software—Or Nearly Free

While many users log on to CompuServe to solve problems or download programs that will make their existing software operate more effectively, it would be madness to ignore the wealth of real, free-standing, useful programs for home and business use to be found in the various forums. Some of the software is totally free of charge (and some of it isn't worth a penny more, so play around with a program before you start writing your next 300,000-word novel on a gratis word processor). This is generically called "Freeware." But please remember that, as we said earlier, some of these programs are "Shareware," whose author is entitled to a small payment ($20 for the latest version of Stuffit, for instance) should you decide to keep and use the program. To that, you must add the actual cost of on-line time. For 1200 and 2400 bps users CompuServe charges $12.50 an hour. Three hundred and 9600 bps connections are charged at the rate of $6.00/hr and $22.50 an hour, respectively. In addition to connect time, there is a network Communication Surcharge. The charge for the CompuServe Network is $ .30/hour; users who connect using another system face different charges. The only other charge is a $2.00/month fee to cover Membership Support Services, which are generally provided free of online connect time charges.

The best way to find out what's out there is to browse (see "Going to the Library" below). A few examples, though, to get you started: The popular and excellent PC communications program ProComm started life being distributed through on-line services. While its offshoot ProComm Plus is now sold through normal commercial channels, the latest version of the highly meritorious original remains on CompuServe for one and all to download. It is to be found in the IBMCOM forum, along with other communications software such as Batmodem.

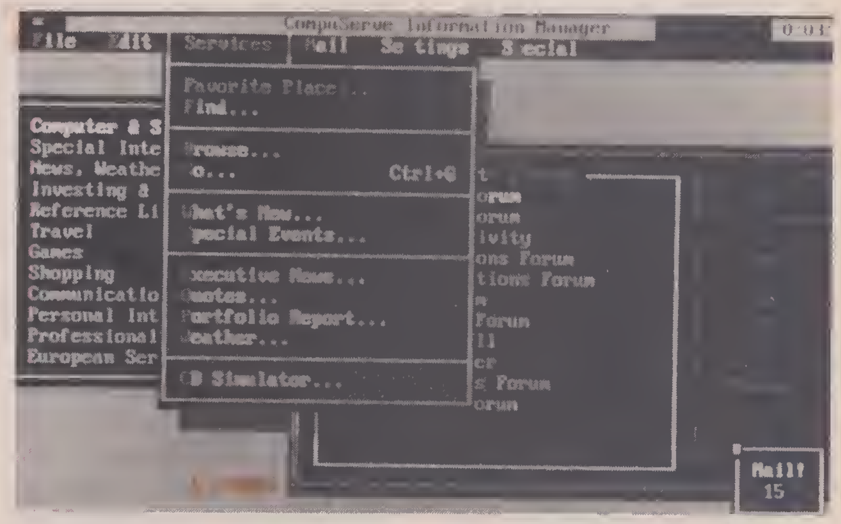
If you need a cheap word processor, CompuServe can help. Type: "GO BPROGA" and you will find yourself in the Borland Programming Language Forum. There, among lots of arcana for bug-eyed micro-freaks, you will find a basic but reasonably flexible text editor called QEdit. You may not want to try writing a complicated academic paper on it, and you certainly won't want to try to create a sophisticated-looking newsletter with it, but for a $60 Shareware fee—payable, again, only after you are sure you want to use the program—you could probably do worse.

You can even find a Russian-language word processor (filename RUSS30.ARC) in the IBMAPP forum—or a Russian module for WordPerfect in the WPSGA forum. The IBMAPP forum is also home to a graphics program: TurboPaint.

Spreadsheets, data bases—just about every category of application is there for the picking if you take your time browsing through the libraries.

Navigating the Æther

Once you have logged onto CompuServe using your user ID and password (best done with the automated log-on procedures of which most communications software is capable—this both saves time and



With enhancement software like the *CompuServe Information Manager,* using its on-line forums and other features becomes even easier.

trouble and saves you from the anguish of a forgotten password), you enter the forum of your choice by typing "GO" followed by the codename of that forum as indicated on the list published herewith. For instance, you can reach the Adobe Systems forum by typing "GO ADOBE" after any CompuServe "!"prompt.

Some companies do not have their own CompuServe addresses, but are grouped together in vendors' forums, the codes for which are indicated in our listing. "GO MACVENA", for instance, will direct you to the Macintosh Vendors forum A (there is also a B and a C, as each can accommodate only a limited number of companies).

On the other hand, some firms have such communicative users that they have had to split themselves into two: WordPerfect is the perfect example. The two forums, incidentally, are run not by WordPerfect Corporation, but by the WordPerfect Support Group (hence the CompuServe addresses "WPSGA" and "WPSGB"). The WPSGA forum is devoted principally to the MS-DOS versions while WPSGB is home to Macintosh and other variations on the WordPerfect theme.

If you don't know the CompuServe address of a company included in the list appended to this article and in which you are interested, or if you want to learn whether they maintain a bulletin board, you can type, for instance, "FIND SILICON BEACH". That "FIND" query would yield the information that the Silicon Beach/Aldus forum can be accessed by typing "GO SBSALD".

Most forums require that you join before you can make full use of their facilities. Fortunately, this costs you nothing, and involves only typing your name at the prompt when you choose "JOIN" from the forum's opening menu.

Inside the Forums

In most forums there are two types of information of interest to us. There are messages and downloadable files. The message area is for user questions and comments and for replies by the sysop, company representatives or other users. Files for downloading are kept in categorized libraries. The opening menu for each forum lets you enter either of these areas by typing a single number.

Going to the Library

For software, printer drivers, demos, upgrades, bug fixes and so forth, you need to look in the forum's libraries. These are divided up by category (e.g., System software, Printer drivers, Fonts, Utilities and so forth). In the past it was sometimes difficult to know where to look for a particular kind of file, but the new version of the CompuServe software lets you browse through all of a forum's libraries at once.

And browsing is what you will be doing, unless you happen to know the exact name of the file you need (having been given it during a tech support phone call or having read it in a magazine article). From the forum's main menu, choose Libraries; you are then presented with a menu of all available libraries. Choose the one in which you think you'll find what you need, then choose Browse, which lets you look at brief descriptions of all downloadable files. If you do not want to check through all files, but want to narrow the choices down, you will have an opportunity to type a keyword to search for. If you are looking for a driver for your new Acme laser printer, for instance, you might type "ACME" for the keyword. Another option lets you define a limit for the age of files through which you are going to browse. For most users it will be best to hit return at this point.

Once you come to the file you need, type "DOW" (for download), choose a transmission protocol supported by your communications software, do whatever your software requires to initiate the transmission, and wait. Some software (especially on the Macintosh) will give you an estimated transmission time; some won't. When the transmission is complete, hit Return. At this point you can continue to browse for other files or you can log off CompuServe.

Chances are the files you download will have been compressed to save on-line time and conserve CompuServe's disk space. Unless they are "self-extracting archives" (this will be indicated), you will need to have the appropriate decompression software (PC files are usually .ARC or .ZIP archives, while Mac files are most often .SIT archives). This is available on CompuServe too; many forums include it in one of their libraries.

Decompression software is also to be found in the IBM-PC and Macintosh system software forums. For the PC programs you'll need to decompress .ARC and .ZIP files, look in Library 6 of the IBMSYS forum; you can decompress Macintosh .SIT files with the Stuffit software you download from Library 6 of the MACSYS forum.

File libraries are well worth browsing through even if your software does not need an upgrade or a fix. Clever utilities abound that can make you and your computer more productive. You can search for them through all CompuServe forums using the Macintosh and IBM-PC (and compatibles) file finders: Type "GO IBMFF" or "GO MACFF" and follow the on-screen instructions for conducting a search. File finder will direct you to the forum and library containing the software or information you want.

Playing Post Office

If you have a hardware or software problem, you will probably want to start with the messages area. Unless your query is very brief and very simple ("What is a merge file?" or "Is there life after death?"), it probably pays to create your message offline using your word processor and saving it in text-only form for uploading. (We are assuming that you know how to operate your communications software.)

But before uploading or typing your question, you really ought to take the time to find out if anyone else has already asked your question and had it answered. We often think we are the only ones to have experienced a given problem, whether it relates to our computer or to our state of health. But as others before us have had gas pains, so too have others had their cursors disappear. Chances are, in fact, your problem is a common one. So before choosing the Create Message or Upload Message option, check existing questions and answers by opting for Search messages. Here you will seethe topics of all messages currently on the system (they do get flushed out periodically to make room for new ones). If you see a topic that could conceivably relate to your query (people are sometimes excessively imaginative in describing the subject of their message), type the appropriate number from the on-screen menu. You will then be able to go through all the forum correspondence initiated by the first message with that subject.

For instance, if your computer freezes every time you try to take a text file created on WordWizard (a fictitious product so far as we know), import it into MagicPublisher (ditto) and print it out on a LaserHype (ditto ditto) printer, you might look at any message in the WordWizard, MagicPublisher or LaserHype forums that speaks of freezes or crashes or mentions any of the other products that form part of the problematic trilogy. Such as "Wizard -> Magic = crash". (Experienced forum-goers are fond of typographical improvisations to make arrows and other dingbats.)

If there is nothing on the forum relating to your problem, go ahead and Create or Upload your message. Once you are done with the text, type "/EXIT"; you will then be asked to provide and addressee and a subject (try to be explicit; you will have to be brief as well as there is a tight limit on subject length). So whom do you send the message to? There are two ways to go. You can address it to "SYSOP" (or to the sysop who specializes in your kind of problem or your particular product—information on this will often scroll by when you first enter a given forum), or to the name of the company. Or you can just address your heart-rending cry to "ALL" in the hope that someone out there hears your SOS. The "ALL" route is especially worth trying on weekends, when the company experts are less likely to check their forums.

You can expect an answer anywhere from an hour to a day or two later. You'll have to keep checking the forum, because in most cases the reply will simply be posted to the forum bulletin board. Occasionally, if your problem is very personal (the computer equivalent of hemorrhoids) the sysop may reply direct to your CompuServe electronic mailbox; in that case, you will see the message "You have electronic mail" when you log on. To retrieve these personal messages, type "GO MAIL" and follow the menu instructions.

As a point of courtesy, do not fail to thank the sender for helping. If the reply requests further information, be as accurate as you can. You may find yourself in a back-and-forth correspondence with another user with experience in your area of difficulty. This can be entertaining as well as useful.

Reading through forum messages you may actually find one that asks a question you can answer. Do not hesitate to type "REPLY" to such a message. By participating in forum life in that way, you help keep the whole system ticking. It is quite gratifying to respond to a call for help, even if it is to the one single question in the world you could possibly have answered. In an on-line forum no one need know how inexpert you actually are!

TAPCIS

The addictive nature of CompuServe can run into money, so it's a good idea to find a way to minimize your online time while maximizing the benefits of using the system. The best way is to handle as much of the overhead off line as possible. Rather than waste online time scrolling through a forum library's catalogue of available files and programs, it's far better to download the catalogue, create a "want list" while off line, and then go back on line to get the desired files.

The same applies to the message sections. All messages are numbered and grouped in "threads." A thread consists of the original message and all replies, and the time involved in following a thread online can be considerable. Again, the solution is to download a list of the message headers, examine it off-line, and the go back on line and "grab" the messages you want to read.

The best way to handle each of these procedures is automatically, using a program called TAPCIS (Total Automation Program for CompuServe Information Service). Most of the time spent using TAPCIS involves telling the program what you want it to do when it goes on line with CompuServe. You can, for instance, tell it log onto a forum and download a catalogue of all files relating to a particular subject. Once the catalogue is on your disk, you can scroll through it and mark the files you'd like to have. TAPCIS will then go back on line and get them. The message area is similarly automated. The program will go on line and get a list of the headers you haven't already seen. You then mark the ones you want to read, go back on line, and TAPCIS will retrieve all of the messages in that thread.

TAPCIS is available, naturally, via CompuServe. You'll find it in the TAPCIS forum, where it is supported by knowledgeable SYSOPs and enthusiastic users beyond counting. The TAPCIS forum's file library, by the way, includes a large number of programs designed to further automate TAPCIS' operations. One, for instance, sorts message headers according to whether you've previously expressed an interest in the subject at hand.

Virus Alert(?)

With any file you place into your computer, either on diskette or by modem, there is always the danger that a virus will accompany it. Some notorious, destructive infections are known to have been spread through small electronic bulletin boards. By contrast, using CompuServe, with its relatively strict controls, is like engaging in safe sex—nearly as much fun, but just about worry-free. Viruses don't really seem to be an issue with files downloaded from CompuServe and similar commercial on-line services. But if you are still concerned, decompress your downloaded files to a floppy disk, then use a virus protection utility (like those from Symantec) to check the files on that floppy before copying them to your hard disk. It would take a very clever hacker to create a virus that could infect your system despite such precautions. There is always the chance, of course, that this is a new virus your protection software does not recognize.

Historically, CompuServe is so safe, and the wealth of information and software available there is so great, that only the paranoid will stay away for fear of viruses. And what other reason could there be to bypass this digital cornucopia? ■

Software and Hardware Companies that Provide Support on CompuServe

1st Class Peripherals
3Com
Abacus
Access Softek
Access Technology
Accolade
ACIUS
Adobe
Advanced Gravis
AI Expert
AimTech
Aladdin Systems
Aldus
Altsys Corporation
Amiga Forums
Apple Forums
Applied Engineering
Artisoft
ASDG
Asymetrix
Atari Forums
ATI/Whap!
Authorware
Autodesk
Avant-Garde
Avatar Corporation
Avery-Dennison
Banyan
Baseline Publishing
BASIS International
Beagle Brothers
Bell Atlantic
Berkeley Systems
Beyond, Incorporated
Big Noise Software, Inc.
Black Belt Systems
BLOC Pubishing
Blyth
Borland
Brightbill-Roberts
Brightwork Development
Broadview Communications
Broderbund
Brown Wagh Software
ButtonWare
CADD/CAM Forum
Campbell Services
Canon
CASE Forum (DCI)
CASEWORKS
Casio Inc.
CD-ROM (Discovery)
CE Software
Central Coast Software
Central Point
ChipSoft, Inc.
Claris
CodeHead Software
Comp Presentation
Computer Club Forum
Computer Language
Connectix
Coordination Technology
Corel
Coromandel
CoStar Corporation
Creative Solutions
CSI
Ctrlalt Associates
Cumulus Corporation
Custom Applications
Custom Technologies
Da Vinci
DacEasy
Data Based Advisor
Data Access
Databook Incorporated
Datastorm
Daystar Digital
DCI/Crosstalk
Dell Computer
Delrina Technology
DeltaPoint
Deneba Software
Design Futures Inc.
Desktop Publishing Forum
Desktop Publishing Vendor Forum
Digital Research
Digital Vision
Digitalk
Double Click
Dr. Dobb's Journal
E-Mu Systems
Echelon Development
Electronic Arts
Enable Software
Epson Forum
EQUIS International
Evolution Computing
Farallon
Fifth Generation
FontBank
Foresight Corporation
Fox Software
Future Soft
Gadgets By Small
Gammalink
Gateway 2000

- GCC Technologies
- Generic Software
- Genus Inc.
- GeoGraphix
- Global Softworks Ltd.
- Global Village Communications
- Glockenspiel
- GO Corporation
- Graphics Software,Inc.
- Graphics Forums
- Great American Software
- Gribnif Software
- Harvard Associates, Inc.
- Hayes
- hDC
- Hewlett Packard
- HI-Q International
- Hooper International
- Hyperkinetix
- Hyperpress Publishing
- Hyphen
- IBM CAD
- IBM Users Network
- IBM OS/2
- IBM Desktop Software Forum
- IBM APPC
- ICD, Inc.
- ICOM
- Impulse
- Independent Computer Consultants Association
- Information Resources Inc.
- InfoWorld
- Inline Design
- Innovative Data
- INOVAtronics
- InSync Software
- Intel
- Interplay
- Intersect Software
- Iomega Corporation
- J.P. Software
- Jasik Designs
- JLCooper Electronics
- Jovian Inc.
- Kidasa
- Knowledge Garden
- Korenthal Associates
- Kurzweil Music Systems - Young Chang
- Legal Knowledge Systems
- Lexicor Software
- Logitech
- Logo Computer Systems, Inc.
- Lotus
- Lucasfilm Games
- Macintosh Forums
- Macola Incorporated
- Magee Enterprises
- Magma Systems
- Mainstay
- Mansfield Software
- Matesys
- Mathematica, Inc.
- MAUG(tm)
- Micronetworked Apple Users Group
- Maxwell CPU
- MCAE
- McAfee Associates
- MECA Software, Inc.
- Megahertz
- Meridian Data
- Meta
- Metz Software
- Michtron
- Micrografx
- MicroIllusions
- MicroProse
- Microseeds Publishing
- Microsoft Corporation
- MicroSolutions
- MIDI Forum
- Misosys
- Multimedia Vendor Forum
- Multimedia Forum
- MultiSoft Corporation
- Mustang Software
- Nantucket
- National Computer Security Association
- NBI
- NetFRAME Systems
- New Horizons
- NewTek
- NeXT Forum
- Northgate
- Novell, Inc.
- nTergaid
- Olduvai Corporation
- On Three Incorporated
- Opcode Systems
- Optronics
- Oracle
- Origin
- Owl International
- Pacific Data Products, Inc.
- Palmtop Forum
- Paradigm Software, Inc.
- Paragon Concepts
- Parsons Technology
- Paul Mace Software
- PDC Prolog
- Personics Corporation
- PKWare Incorporated
- Playroom
- Pocket Soft, Inc.
- Polaris
- Poqet Computer
- Portfolio Systems
- Power Industries LP
- Practical Peripherals
- Practical Solutions
- Precision Software
- Primavera Systems
- PRO-C Corporation
- Procomm Technology, Inc.
- Professional Press (VAX Forum)
- Pub Tech
- QMS
- Qualitas
- Quarterdeck
- Quercus Systems
- Quicksoft
- Radius Incorporated
- Reality Technologies
- Revelation Technologies
- Right Answers
- RIX Softworks
- Roykore
- Rupp Corporation
- Salient Software
- Saros
- Schemers, Inc.
- Scitex America
- Seven Hills
- Shareware Marketing
- Sharp Electronics Corp.
- Sierra On-Line
- Sigma Designs
- Sitka (TOPS)
- Soft-Logik Publishing Corp.
- Softbridge
- SoftCraft
- Softview
- Software Publishing Corporation (SPC)
- Software Ventures
- Software Toolworks
- Software Publishers Assoc.
- Softwood
- SPECTRA Publishing
- Spectrum HoloByte
- Spinnaker Software
- SSI
- Standard Microsystems Corporation
- STB Systems
- Stirling Group
- Stone Edge Technology
- subLOGIC
- SuperMac Technology
- Supra Corp.
- Survivor Software
- Symantec
- Syndesis
- T/Maker Incorporated
- TACTIC Software
- Tandy Corporation
- Tandy Users Network
- TAPCIS Forum
- Tech III
- Telecommunications Forum
- TENpointO/Activision
- Terrapin, Inc.
- Texas Instruments Forum
- The Voyager Company
- Three-Sixty Pacific
- TIMESLIPS Corporation
- Timeworks
- TMS Peripherals
- Toshiba
- Traveling Software, Inc.
- Trend Micro Devices
- True BASIC, Inc.
- TurboPower Software
- Turtle Beach Systems
- Twelve Tone Systems
- UK Forum
- Universal Technical Systems, Inc.
- UNIX Forum
- Ventura Software
- Vericomp
- VideoLogic
- Whitewater Group
- WilsonWare
- Within Technologies
- Wolfram Research
- WordPerfect
- WordStar
- Wordtech Systems
- Working Software
- WPMA
- WUGNET
- XChange
- Zenith Data Systems Forum
- Zenographics
- Zeos International
- ZSoft Corporation

For Serious Security Only: Tape Backup

There's more to adding a tape backup drive to your system than just popping in a board, but the extra effort is worth it for the sake of your peace of mind the next time your hard disk crashes!

Deep down you know that you should be backing up your hard drive. It's not that you like to court danger, or are unaware of the potential disaster that awaits you if you don't keep copies of your hard disk data. It's just that backing up a hard drive onto a zillion floppy disks is not your idea of a fun afternoon. Especially now with heavy-duty *Windows* and DOS programs adding megabytes to many hard drives, backing up with floppies has turned from a minor inconvenience to a major hassle.

Clearly, using floppy disks to archive the data on your hard drive is not the solution. The alternative is the streaming tape backup—pop in a cartridge, press a button, and your entire hard drive is recorded onto the tape. No more swapping floppy disks in and out of the drive during the backup; it's all automatic and the entirc contents of the drive are stored neatly a single tape.

But tape backup drives cost a lot of money, don't they? That used to be true, but it isn't any more. You can now buy a high-quality internal tape drive system for under $250. That's cheap, considering that it'll cost you a minimum of $200 to have someone extract the data from a hard drive should something go wrong with it (and that's for a a 20 or 40 megabyte drive; it could cost over $1,000 to extract the data on a damaged 100 or 150 megabyte drive).

But tape backup drives are difficult to install, aren't they? That's no longer true either. In fact, the most popular models don't require any special add-on boards or installation. Just pop the drive into your computer, snap some wires into place, and you're ready to go. Of course, you can also opt for a tape backup that uses its own add-in card. Installation takes a while longer, but the backups go about twice as fast.

Let's take a closer look at the art and science of installing a tape backup system. You'll learn how to select the right system for your needs and how to get it working in your computer.

Which to Choose?

There are two general forms of tape backup systems: internal and external. Internal models fit inside your computer, generally taking up the same space as a floppy disk drive. Unless you have special requirements, an internal drive is the recommended way to go, because it is easier to install and generally cheaper than the external type. But your computer must have room for the drive. Unlike a hard disk drive, which you can effectively hide anywhere inside the PC, the front of the tape backup must be accessible from the outside of the machine—obviously, to insert the tapes you'll use for the backups.

All is not lost if all the drive bays in your PC are already in use.

First, consider moving the hard drive, if possible. If the drive is small, you may be able to mount it beside the drive bay in its own compartment, or near the power supply. The case design of many compact desktop models allows for this. If you have an older PC equipped with full-height floppy drives, consider changing them for half-height models. Two drives will then take up the space of one, and that'll leave a bay open for the tape backup drive. Consider, however, that new floppy drives will cost about $70 each. Unless you've been wanting to purchase new floppy drives anyway, you may be better off spending the extra money on an external tape backup model.

External tape backup drives cost more because they include their own case and power supply (the internal units borrow power from your PC). The cost difference can be between $100 and $500, depending on the model and manufacturer. On average, external tape drives cost about $150 to $200 more than their internal cousins. External tape drives also connect to your computer only by way of an add-on board that you must install. The board provides the electrical connection between the PC and the drive, and serves as the device controller.

Conversely, internal tape drives connect to the computer in one of two ways: with a separate controller card, as with the external models, or through the existing floppy drive controller board. By using the floppy drive controller, the tape drive doesn't need its own dedicated controller card. That makes it easier to install, and you don't have to worry about using an extra expansion slot in your PC. The tape drive can be used whether your computer has one or two floppy drives. At most, you'll need a replacement cable with one input and three output connectors. The input attaches to the floppy drive controller card already inside your PC. The three outputs connect to the two floppy drives and the tape drive. Note that this cable is often not included with the tape drive. You need to purchase it separately, at a cost of about $30.

This internally mounted tape drive from Maynard uses your computer's own floppy disk controller, making installation much easier.

The disadvantage of using the floppy drive controller is backup speed. It takes roughly twice as long to back up a given hard drive using a floppy drive controller as a dedicated tape backup controller card. For example, it might take 20 minutes to back up 80 megabytes of hard disk data when using a floppy drive controller, but only 10 using a dedicated controller. Most people will find that the extra minutes aren't really wasted, as the backup process is largely automatic (exception: when there is more data than will fit on a single tape). During the backup, you can take a coffee break, walk the dog, grab a bite to eat, or whatever.

Dedicated controllers can also employ a more elaborate form of hardware data compression, so that you can store more bytes on a single tape. Not all controllers have a data compression feature, so be sure to check first before buying.

The dedicated controller much match the tape backup you are using. For example, if you are installing a Colorado 120 MB internal tape backup system (manufactured by Colorado Memory Systems), you'll need to purchase either the FC-10 or the TC-15 controller card, also made and sold by Colorado Memory. There's no such thing as a "generic" tape backup controller card.

Which Size?

Now you know that tape backup drives can be either internal or external, and the internal models can use either a dedicated controller card, or borrow the existing floppy drive controller already installed in your computer. There are two more features differentiating drives: the type of tape media used and the format of the recorded data on that tape.

The two most commonly used tape types are the DC 600/6000 and the DC2000 (these are actually 3M part numbers, but they are generally used to identify the overall tape format). The DC600/6000 tapes are physically larger, able to hold as much as a half a gigabyte of data. They are most often used with tape drives employing the QIC-11, QIC-24, and QIC-120 tape formats.

The DC2000 tapes are about the size of an audio cassette tape, only a bit thicker. They are typically employed with tape drives using the QIC-40 and QIC-80 formats. By the way, for those interested, "QIC" comes from Quarter Inch Cartridge, named for the width of the tape used in both tape types. The QIC formats are supervised by a committee, sponsored by several tape drive and tape media manufacturers. While the QIC formats offer some degree of compatibility, most tape drives employ some proprietary functions, either in the design of the interface, the data compression used to pack more information on the tape, or both.

Of the two types, the DC2000 has become the more popular because of the lower cost of both the drives and the tapes. The tapes are available in four capacities: 80 and 120 megabytes for "120 MB" drives, and 160 and 250 megabytes for "250 MB" drives. For 80 and 160 megabyte capacity, the data cartridges are packed with 205 feet of tape, and for 120 and 250 megabyte capacity, the data cartridges are packed with 307 feet of tape. Those capacities are rated with optional data compression turned on; without the compression the capacity is roughly halved. For example, if you're using a 120 megabyte tape (such as the 3M DC2120 tape) on a "120 MB" drive, but with compression turned off, the actual capacity will be only about 60 megabytes.

Choosing a Tape Backup

With so many options to choose from, it can be difficult to decide which is best for your needs. However, you can readily identify the best type of drive to use based on the physical requirements of your computer and the amount of data you must back up.

You'll probably opt for an internal drive if your computer has the room for it. You then have a choice as to whether you want to use a dedicated controller or connect the drive to the floppy controller card. As noted, the backups are faster with a dedicated controller, but the controller adds complexity (as you'll soon see), and is not exactly cheap. For example, the list price for the Colorado Memory Systems FC-10 8-bit controller is $129. The list price for their FC-15 16-bit controller is $299 (this model employs proprietary data compression as well, which the FC-10 lacks).

If there isn't enough room inside the computer for a tape backup, you'll need to install an external model. This will require the use of a dedicated controller card, which adds to the overall cost of the backup system.

Choose a tape system that will hold the data on your hard drive. For best results, the backup system should be able to store the entire contents of a hard drive on a single tape. However, this is not always a realistic goal, nor is it always necessary. For one thing, few users have their hard drives filled to the brim. For example, a 160 megabyte hard drive may only have 100 megabytes of data on it. Unless you plan on adding new software, you don't necessarily need a tape backup system that can store all 160 megabytes on a single cartridge.

Secondly, the backup software that comes with the tape drive is generally smart enough to split an oversize hard drive into two or more tapes. You'll always be able to back up the entire hard drive, even if it's a whopper, but you may have to swap the tapes once or twice during the backup. This is nothing more than a minor inconvenience.

Thirdly, you don't need to back up the entire drive each time. A perfectly acceptable backup plan is to make one full backup every week or two, and then in-between make smaller "incremental" backups of just the new or edited files. It's a good idea to make an incremental backup once a day, using a separate tape than the one that holds the "full" backup. You can store multiple incremental backups on the same tape, until you overrun its capacity. That way, you won't waste a whole tape on just a 100K or so of new or edited files. (At about $35 per DC2120 tape, you'll want to find ways to re-use them).

And finally, you may not want to back up all the files on your hard drive, especially if it's easier merely to re-install the programs in case of a hard disk catastrophe. For example, rather than backing up the program files for *Excel* and *Word for Windows*, just back up your data and any "customizing" files you may have created. If anything goes wrong with the hard drive, you can more easily re-install the software from the original distribution diskettes. (Note: because *Windows* creates many new files as you use it, we recommended backing up all of its files. Don't rely on re-installing the *Windows* software.) You'll also want to avoid backing up unnecessary files, like the temporary or permanent *Windows* "swap file." The swap file doesn't contain anything you need to keep, and by not backing it up you can save several megabytes of tape space.

Installing a Tape Drive

If you're getting the idea that choosing a tape backup system is tougher than installing it, you're right! Let's review the steps required to install three types of tape backup units: internal, connected to floppy disk controller; internal, connected to dedicated controller; and external, connected to dedicated controller.

All three require that you remove the cover of your computer. Here are the general steps: 1. For safety, park the heads of the computer's hard drive; 2. Turn the computer off, and unplug it; and 3.Remove the top cover of your computer (or, if it's a tower case, remove the left or right side panel, as needed).

Do not touch any internal part before first draining the static electricity from your body. If possible, touch any grounded metal object (the power supply in your computer is not a good choice, as it is no longer grounded because the PC is not plugged in). Or you can drain any residual static buildup by touching a metal object, like a doorknob.

Internal, Floppy disk Controller

You must first find a vacant drive bay for the tape backup unit, then install it. The exact mounting procedure will vary depending on the design of the tape backup unit and your computer. Most installations require only that you:

1. Remove the bezel covering the drive bay you want to use.
2. Install a set of plastic rails on the sides of the tape backup unit.
3. Slide the drive into the empty drive bay until the rails click in place.

If your tape drive doesn't come with mounting rails, or if the case of your computer doesn't accept them, you'll need to mount the unit using the hardware that is generally supplied. In some cases, you may need to purchase mounting kits to install the drive in certain types of computers. For example, if the drive must be secured to the bottom of the drive bay, you'll need a mounting bracket especially designed for this. Or if you're installing the drives into a PS/2 tower model, you may need to purchase offset rails and face plates. The moral: It's always a good idea to ask what extras you'll need before you bring the drive home. You'll save plenty of time and energy that way.

With the drive installed, you must connect it to the floppy drive controller and to the power supply: If your computer contains only one floppy drive, you can probably use the existing floppy drive data cable for both the floppy and the tape units. Locate the unused end of the data cable and plug it into the back of the tape backup. Be sure to observe orientation. The red or blue mark on one edge of the data cable connects to pin 1 on the back of the tape drive.

If your computer already contains two floppy drives, you'll need to replace the data cable with one that allows the connection of three drive units. As mentioned earlier, this is usually an optional part that you must buy separately. Caution: Data cables are available in a couple of different versions. Be sure to get the one for your brand of computer and the type of floppy drive controller you are using.

You also need to attach the drive to the power supply. Find an unused disk drive power "harness" (two, three or four wires, terminating in a small plastic connector). Plug it into the power receptacle on the back of the drive. The connector will go one way only. If there are no free power supply harnesses available, you'll need to attach a "Y" cable to split one harness into two connectors. Like the data cable, the "Y" connector is often an optional part you must buy separately.

Last, and certainly not least, be sure to connect the grounding wire to the tape drive, if the manual so recommends. Failure to do this could lead to erratic results, or damage to the tape drive.

That completes the steps required to install an internal tape drive using the existing floppy controller card.

Internal, Dedicated Controller

The basic steps steps are the same when installing an internal tape backup system using a dedicated controller. However, instead of attaching the drive to the floppy disk controller, you must install a separate controller board and attach the tape unit to that.

1. Locate an empty expansion slot inside your computer. Note the type of slot—either 8- or 16-bits (8-bit slots consist of just one long connector; 16-bit slots consist of one long and one short connector).
2. Remove the panel plate on the back of the computer to allow room to add the controller card (save the screw for step 5).
3. Refer to the instructions that came with the card on how to set it up for your computer. Don't assume the controller card is already set and ready to go. There may be switches or jumpers to set before you install it. You'll need to pay particular attention to the address and interrupt used by the controller card. The address and interrupt must not already be in use by another card in your computer (like the hard drive card). To be sure, consult the documentation for the computer, or use a diagnostics program like *Check It*, which can provide many of the hardware-level details of your computer.
4. Carefully insert the controller card into the expansion slot. Be sure it is completely seated in the connector.
5. Insert the screw into the bracket on the back of the controller to keep it from working loose.
6. Attach the supplied data cable between the controller card and the tape drive. Be sure to observe proper orientation of the cable.

That completes the steps required

to install an internal tape drive using a dedicated controller card.

External, Dedicated Controller

Externally installed tape drives require only that you install a controller card inside your computer. As with the internal units that use a dedicated controller, be sure that the card is properly set up before you install it. Otherwise, the drive, your computer, or both won't work.

The external drive unit connects to the controller card using a shielded cable. Connect the cable between the drive and card. If the cable uses brackets, locks, or screws to hold it in place, be sure to use these, or the cable could work loose.

Installing Software

Installation of your tape drive is almost complete. But before you can use it, you must install its software. Most tape drive systems come with an installation program that automatically places the backup software on your hard drive. Be sure to follow the software installation instructions. Most problems with tape drives stem from improperly installed software, so be sure to do it right the first time.

Tape systems that use a dedicated controller usually require a special driver program. This driver tells your computer how to access the tape backup hardware. Typically, the driver is installed during the boot-up process. Instructions to the computer for loading the driver are included in the CONFIG.SYS and/or the AUTOEXEC.BAT file.

Drive systems that use the floppy controller card usually don't require driver software.

To back up your hard drive, start the backup software as detailed in the operator's manual. Follow the directions for formatting and backing up the data. You may want to test the integrity of the archived data by backing up a test file, then restoring it. Examine the file to be sure it isn't corrupted. If there are problems, see our troubleshooting tips below. ■

Troubleshooting Guide

Having troubles with your tape backup system? Check these common faults and their cures:

Problem: Computer won't recognize the drive. *Likely causes:*

- Driver software not installed correctly.
- Controller card not properly set up.
- Data cables loose or backward.
- Drive not receiving power.
- Drive ID incorrect (SCSI interfaces).

Problem: Computer won't start with tape drive controller card installed (or reports an error). *Likely causes:*

- Driver software not installed correctly.
- Address and/or interrupt conflict; check settings and choose new address and/or interrupt for the tape backup controller card.

Problem: Drive reports write-protect on. *Likely causes:*

- Write protect tab not in "Record" position on tape cartridge.
- Write-protect switch faulty in tape drive unit.

Problem: Drive won't record data. *Likely causes:*

- Driver software not installed correctly.
- Controller card not properly set up.
- Data cables loose or backward.
- Tape not properly formatted.

Problem: Restored data corrupted. *Likely causes:*

- Driver software not installed correctly.
- Controller card not properly set up.
- Data cables loose or backward.
- Recording heads dirty or misaligned.

Problem: Backups taking longer than usual. *Likely causes:*

- Sector error on hard drive.
- Corrupted data on hard drive.
- Recording heads (data system) dirty or misaligned.

Maynard Archive XL Cartridge Tape System

The Archive XL is Maynard's offering for the low-cost ($499) tape backup market. While the Archive XL doesn't qualify as the best product in its price range, it does offer solid hardward and a quality software package—all backed up by good tech support.

We tested the model 5580i using a standard IBM-AT clone machine. The 5580i uses the computer's own floppy disk controller. Most XT/AT-compatible floppy disk controllers were designed to handle a maximum of two drives, so If your system already has two drives installed, you'll need Maynard's $99 XL20A adapter card.

Installation requires opening the computer's case. Prior to installing the drive you must configure it for proper operation by setting the drive select jumpers found on the rear of the drive next to the I/O connector. A pair of needle nose pliers simplifies this task. The 5580i comes configured as the second drive for an AT-type system: If your floppy drive has a terminating resistor already installed, you'll need to remove the one on the tape drive.

Assuming you have room in your computer's case, all you'll have to do is mount the 5580i in an unused floppy bay and connect the power and signal cables for the second drive. (You may need to remove the AT-style rails, depending on the type of computer case you have.)

Some of the new small-footprint cases don't have the same configuration, and you'll need to follow the instructions closely. Be aware that one area of particular concern covers the installation of a termination resistor.

In a word, hardware installation can range from the simple to the intimidating. If your system's configuration seems to be pointing towards the latter, and if you are not used to these things, you can always have your dealer do the work.

Software installation consists of copying two files onto your hard disk. The menu-driven *QICstream* software performs all the necessary functions to back up your hard disk. You can select individual files or entire disk drives for backup.

For a simple backup with no data compression or verification you can expect speedy operation. It took only 8 minutes 20 seconds to back up 17.5 Mbytes, or approximately 2.1 Mbytes per minute. With compression the time just about triples.

Overall, then this works out to around 760 K per minute, compared with the drive's rated speed of 2.4 Mbytes per minute, but that rating doesn't include the inevitable tape positioning overhead. As data compression requires more CPU power, you'll see better times on machines faster than the 10 MHz '286 we used.

A file manager screen allows you to back up only a portion of the disk, choosing files by name, directory or date. You can also select only the files that have changed since the last backup. *QICstream* lets you secure your backups with a password (be careful with upper/lower case letters as *QICstream* is case-sensitive). If you happen to forget your password you can forget about the data on that tape as well. Maynard offers no way to get to data that has been protected without knowing the password.

One nice feature of the backup portion of the *QICstream* software is a running bargraph indicating progress. At the completion of the backup a summary screen shows the total elapsed time along with the number of bytes saved and the number of bytes free on the tape.

When restoring, you may redirect the files to another directory path; this lets you easily reorganize a hard disk or move data from one machine to another. You can also restore a selected portion of the files from the tape.

Both the installation and the *QICstream* manuals provide all the information necessary to get your tape system up and running in no time. The *QICstream* manual includes numerous screen shots of the software and a complete index.

Maynard's normal technical support hours of 8:30 A.M. until 8:00 P.M. EST weekdays offer full-service, toll-free support. Other times (24 hours a day, but only five days a week) are handled using a call-back system.

The Archive XL system offers reliable, fast backup in a reasonably priced package. The *QICstream* software adds the finishing touch to make the chore of backups a bearable one.

Maynard
36 Skyline Drive
Lake Mary, FL 32746
(800) 821-8782

Prices:

5580i 80/120 MB tape drive, $499
XL20A Adapter Card, $99
380F 80 MB QIC-80 tape, $40
M1120B 120 MB QIC-80 tape, $45

Irwin AccuTrak Plus Cartridge Tape System

The Irwin Accutrak Plus 250 Mb tape backup system provides a fast efficient way to accomplish the task most people say they need to do but don't. The drive will pay for itself the first time you need a file that you accidentally wrote over. The Accutrak Plus retails for $479, and the 4100A 1-Mbps (Mbyte/sec.) controller costs an additional $179.

The first item of business is to know that performance specifications such as 1Mbps are practically meaningless. If throughput were equivalent to the rating of the tape drive controller card back up times of 60Mb per minute could be achieved. The physical limitations of the tape drive itself makes for throughput times more like 4Mb per minute.

We were able to back up 30.6 MB using the DOS software with no data compression in 7 minutes and 5 seconds. That works out to a reasonable 4.32 MB per minute. Using data compression 150.7 MB required 70 minutes for a rate of 2.15 MB per minute. That's still pretty fast considering we used a 12 Mhz 80286 based machine. You can expect to see even faster times for data compression using a speedier CPU.

No tape backup system can function without usable software. Irwin offers two options for DOS and Windows users. The EzTape for DOS software provides a menu-driven interface, while EzTape for Windows provides a fully Windows 3.0 compliant software package.

The installation process requires you to open up your computer and locate an empty 8-bit slot closest to the bay in which you'll install the tape drive. Although it doesn't really matter how far away the controller card is from the tape drive, it is always a better idea not to have the ribbon cable snaking its way half way round the interior of the PC. Once the controller card has been installed, mount the tape drive itself. The drive will fit in any half-height floppy position. If your case doesn't require AT-style rails, remove them from the drive first. The next thing to do is to connect the power and data cables to the drive. Irwin provides a "Y" connector in case there are not enough connectors coming off the power supply. As long as your power supply is large enough, a tape should eat up about 10 watts, do not be concerned about overloading the system by using the Y connector. Irwin also provides ample length ribbon cables.

EzTape for DOS provides a menu-driven program for all backup and restore operations. The software comes on two 5 1/4-inch floppies and has an install program on the first disk. The EzTape software will save your default parameters for use later. There are a number of useful programs to be found on the software. EzLIB program maintains a library database of tape backup sets. This allows a user to automatically backup only certain directories rather than the entire hard disk. Set One, for example, might be your word processing directory, set two, spreadsheets. The handy search feature allows you to search multiple backup sets for a particular file. EzStart helps you to automate the backup process and enables you to specify a time and date to perform your next backup. It uses parameter files and the EzTape program to accomplish its task.

EzTape for Windows uses the bells and whistles of Windows 3.0 to provide a slick interface to cure all your backup woes. It combines all of the features from the DOS programs into a single unit. You'll need a machine with a minimum of 3 MB of RAM and at least EGA video to execute the program.

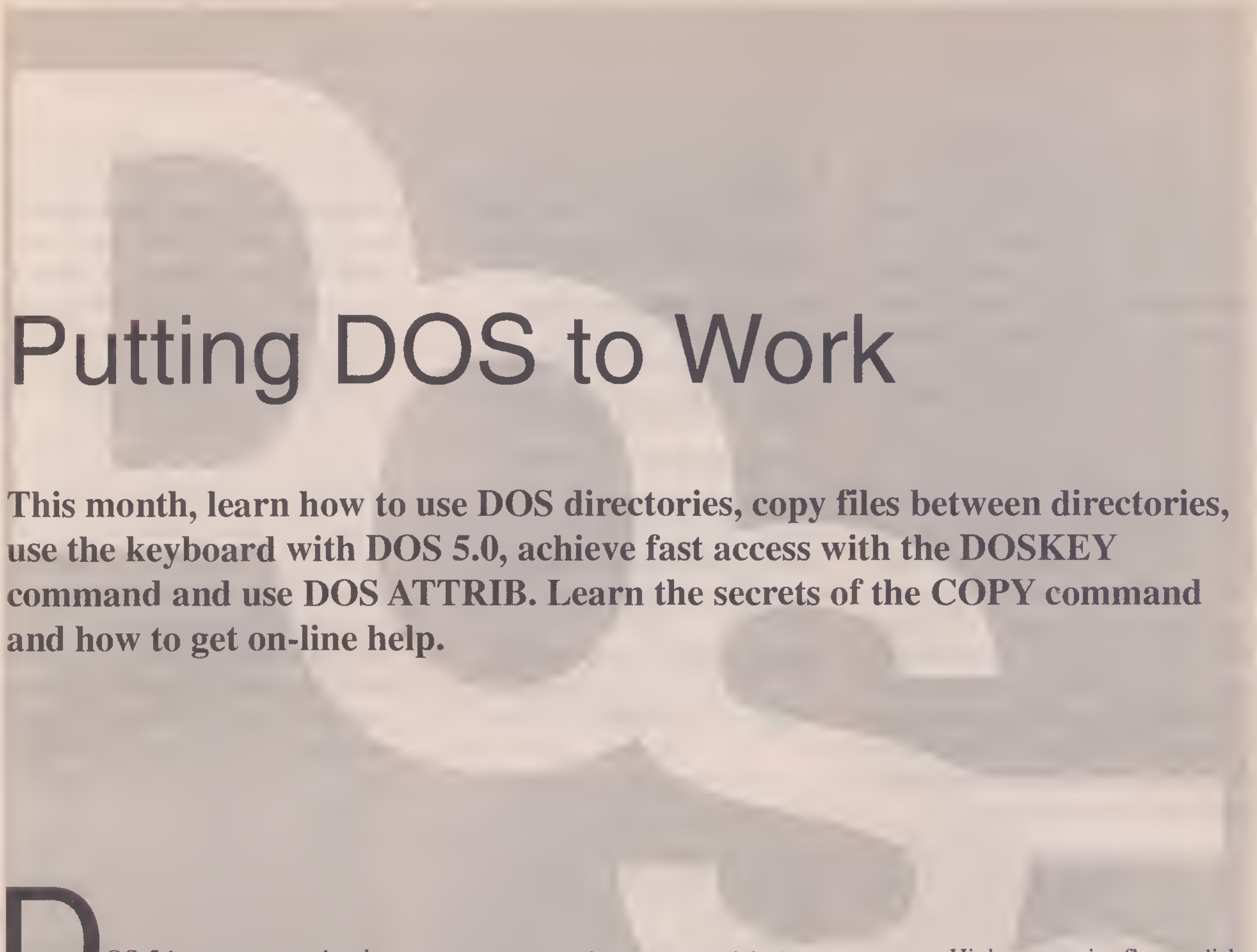
The manual set has been logically divided into separate books for hardware and software. The hardware manual takes you step by step through the installation process. It even details how to install the drive in specific, non-standard, machines like an IBM AT and a Compaq Deskpro. The EzTape for Windows manual does a good job of documenting the features of the program.

Irwin provides a toll-free technical support service available 8:00 A.M. to 7:00 P.M. EST, Monday through Friday. We tried it a number of times and experience waits of up to five minutes, but it is toll free. By the way, their support staff handled most any question we threw at them. When we did stump them, they called back with the answer quickly.

The Irwin AccuTrak Plus system provides a high-performance tape backup system at a reasonable price. The addition of the 4100A SuperTrak controller makes installation a snap. The latest bundle offers both DOS and Windows 3.0 software for added versatility. If you need fast, reliable backup, you'll find a good buy in the AccuTrak Plus. ■

Irwin Magnetic Systems, Inc. 2101 Commonwealth Blvd. Ann Arbor, MI 48105-1561
(800) 524-7946; (313) 930-9000

Prices: AccuTrak Plus 250 MB Tape Drive and Software $479; 4100A Internal/External SuperTrak Controller, $179; 2000-120 Preformatted extended length tape, $42



Putting DOS to Work

This month, learn how to use DOS directories, copy files between directories, use the keyboard with DOS 5.0, achieve fast access with the DOSKEY command and use DOS ATTRIB. Learn the secrets of the COPY command and how to get on-line help.

DOS 5 has proven to be the most popular of all Microsoft's incarnations of DOS. Its rich collection of features is part of the reason. Some are new, some are old, some are improved. In this article, we review several of the more important "tips and tricks" of DOS 5 features. You'll learn how to use disk directories, the special function keys, the new DOSKEY command, extended DIRectory command functions, the ATTRIB command, the special "hidden" features of the COPY command, and the DOS 5 on-line HELP facility.

Understanding Directories

This primer will guide you through the hard disk directory maze. You'll learn what directories are and how they are used, limitations in directory names and structures, how to create directories on any disk (not just a hard disk), and how to freely roam through the directories on your disks.

What a Directory Does

Every disk (floppy or hard) has at least one directory. This main directory is the root. Barring the use of additional directories on your disk, the files you copy and create on your computer will be located in the root directory.

Floppy disks are often limited to just the root directory, because they hold a relatively small number of files. The standard 360K PC floppy disk can hold no more than 112 files, regardless of the physical size of the files. This limitation is based on the directory structure of the disk. The directory contains a list of the names of all files on the disk. The length of the list is preset when the disk is formatted, and has slots for just 112 file names. Higher capacity floppy disks can contain more files, but again, the maximum number of files is dependent on the directory capacity.

Hard disks offer many times the storage capacity of floppy disks. Even the relatively "small" 20 megabyte hard drives—used mostly on PC/XTs and clones, can hold 56 times more data than a 360K floppy disk. The average hard disk for an AT-class machine is on the order of 40Mb, or about 111 times the capacity of a floppy. With so much space available, sprinkling files in one huge directory would make it difficult to locate the file you want.

As with floppy disks, the root directory of a hard disk is engineered to accept only so many files before it fills up. The average 20Mb hard drive has room in the root directory for only 512 files. Instead of fitting 56 times the data on the hard disk, you can cram less than five times into just the root directory.

This is where subdirectories (or just plain "directories") come in. A subdirectory is a separate directory that branches off the root. Think about the shape of a tree. The root and trunk of the tree are like the main directory on a computer disk. Growing from the trunk are limbs—subdirectories. From these limbs there may be additional branches, perhaps splitting off many times before ending up at the leaves. The leaves are the "data files" in our organic analogy.

Like the tree, a root directory on a computer disk can branch off into many independent subdirectories. From these directories, there can be additional directories. For practical purposes, few hard disks use more than two levels of directories.

The organization and names of the directories on your hard disk are completely up to you. If you've just formatted the hard drive, it contains no files or subdirectories. It's like a blank canvass waiting for paint. At this point, you should take a few moments and decide what directories you want on your disk, and how they will be arranged. Most PC users create a separate directory for each program they own—Microsoft *Word* in one, Lotus *1-2-3* in another, etc. Additional directories are often created under these program directories for holding documents, help files, printer drivers, and so forth. These "sub-sub" directories contain files that are related to the programs held in the higher directory level.

CREATING A DIRECTORY

You can create a directory anywhere on a disk—from the root directory or from another directory. The root directory is the most common spot to create a new directory, so we'll use that as our example.

To create a new directory, start your computer in the normal fashion. Log onto the drive you want to use (Most often, this will be your hard disk, which will already be active.) At the DOS prompt (A> or B> for a floppy disk; C> or D> for a hard disk), type:

MKDIR **subdir**

In place of subdir type the name of the directory you want to create. The MKDIR command is short for "make directory." As with DOS filenames, you are limited in the characters and length of directory names. Directory names can be up to 11 characters long, and can contain only those characters acceptable as a DOS filename, i.e., no spaces, colons, backslashes, commas, and so forth.

As a shortcut, you can use the short-form of the MKDIR command: MD. Type:

MD **subdir**

to create the directory of your choice.

> **Although the root directory is the most common spot to create a new directory, you can create a directory anywhere on the disk—the organization is up to you.**

MOVING TO A DIRECTORY

The directory you created in the previous section now resides on your disk, but it's not yet current. When your computer starts, it automatically activates the root directory on your disk. The root directory is now current; commands you type at the keyboard affect the files in the root directory. The current directory is often referred to as the "default." To work on files in another directory, the easiest way is to make it the new default. That requires that you "move" to that directory using the CHDIR (for "change directory") command. At the DOS prompt, type:

CHDIR **subdir**

Like before, exchange subdir for the actual name of the directory that you created. Or, you can use the short-form of the CHDIR command, which is CD. Since you'll be using the change directory command often, it's a good idea to get used to the short-form, to cut down on your typing.

Subdirectories behave just like the root directory. Typing DIR at the DOS prompt displays a directory of files. Since you just created the directory, it will be empty, except for two entries, shown only as a single and double period. The single period means "this directory," and the double period means the "parent directory." You can ignore these two entries for now. Soon you'll learn how to use the double period to navigate through the directory structure.

Note that when viewing a disk directory with the DIR command, beside the names of directories is the destination <DIR>. This lets you know that the name is for a directory, not a file.

Before you copy or create files in a directory, you should make sure you're in the right one. Ask for a DIRectory, and note the directory name that appears. Or, type CD (with no directory name). Your computer will respond with the name of the current directory.

Now that you're in a subdirectory, you can create another one, and make it current. Or, you can move back to the root directory. To get back to the root directory, type:

```
CD \
```

The backslash without a directory name after it means "root directory." If you have other directories already created on your disk, you can instantly log into them by typing their name after the backslash, as in:

```
CD \otherdir
```

The otherdir directory is the name of another directory on your disk. Again, type DIR or CD to check that you are in the proper directory. Note the name of the directory on the screen.

Your computer keeps track of all directories (root and directories) by path names. A path is the course from the root directory to the destination directory. That path may have any number of intermediate directories. Path names may look complex, but they really are quite simple. Each directory name in the path is separated by a backslash. Suppose, for example, that you want to move to a directory that is located under yet another directory. These directories are Subdir1 and Subdir2, respectively. To instantly activate (and therefor make current) the Subdir2 directory, type:

```
CD \Subdir1\Subdir2
```

You can type this command at any spot on the hard disk, regardless of the directory you're currently in. The first backslash in the path name means "start from the root directory." Because you included this backslash, the computer interprets this command as an absolute path name.

Leaving off the beginning backslash causes the computer to consider the command a relative path name. Your computer will assume you want to move to a directory path starting at the current directory. If the directory you want to move to isn't under the current directory, you will get an error.

- Use relative paths to move first to the root directory, then to Subdir_B.
- Use absolute paths to move directly to Subdir_B.

The relative path approach requires more typing. You must first move to the root directory by typing the following sequence:

```
CD \
CD Dir_B
CD Subdir_B
```

You can also combine the last two commands into one:

```
CD Dir_B\Subdir_B
```

Using absolute directory paths is a more straightforward approach:

```
CD \Dir_B\Subdir_B
```

If you'd like to move up from one subdirectory to a higher level, regardless of the name of the directory, you can use the CD .. command. This command moves you from the current directory to the directory just above it—from Subdir_B to Dir_B, for example, or from Dir_B to the root directory. The CD .. command is helpful if you don't know the full path of the directory, or if you just want to quickly move between directory levels.

COPYING FILES BETWEEN DIRECTORIES

Moving to a different directory on your hard disk lets you easily look at and access files in that directory. You will most often use the CD command to maneuver around your hard disk to use various programs. Another task that is often required is copying files between directories. The procedure is similar to copying files from one disk to another, except that the files are duplicated between directories on the same disk.

You can copy files no matter where you are on the disk, but the task is the easiest when you are in either the source or target directories. The source is the directory that contain the files you want to copy; the target is the directory where the files will be copied to. To copy the files, use the full path name to indicate the source and/or the target.

For example, suppose you're currently in the COMM directory, which you use when talking to other computers via a communications program. You want to copy a file named MYFILE.TXT, which resides in the WP50 (for WordPerfect 5.0) directory. From the COMM directory, type:

```
COPY\WP50 \MYFILE.TXT
```

DOS will automatically fetch the file in the indicated source directory, and copy it in the current directory. Because you didn't stipulate another name for the copy, DOS assumes you want to keep the filename as MYFILE.TXT.

If you're already in the WP50 directory, and want to copy the file to the COMM directory, you'd enter:

```
COPY MYFILE.TXT
\COMM\NEWFILE.TXT
```

The first portion of the COPY command indicates the name for the source file, which currently resides in the default directory. The second portion indicates the name of the copy, which is to be placed in the COMM directory. This example specifies a name of NEWFILE.TXT for the copy, but you can keep the old name or choose any other name you like.

Beyond this example, you can copy files from one directory to another, even if you aren't in the source or target directory. Merely indicate the full path for both the source and the target files, as in:

```
COPY \WP50\MYFILE.TXT
```

```
\COMM\MYFILE.TXT
```

If you need to copy a file to a directory on another disk, provide the drive letter in front of the path:

```
COPY
C:\WP50\MYFILE.TXT
D:\COMM\MYFILE.TXT
```

You'll often use cross-disk copying when transferring files between a floppy disk and hard disk.

DELETING DIRECTORIES

Sooner or later, you'll want to delete a directory from your hard disk. Perhaps you no longer need the files contained within the directory, or you want to move the files to another location. Follow these steps to delete a directory:

1. Delete ALL the files in the directory. Be absolutely sure you're in the proper directory, or you could delete files you want to keep.
2. Move to the next higher directory (use the CD .. or CD \) commands.
3. Type RMDIR subdir (or RD subdir). Substitute subdir with the name of the directory you want to delete. If you're in the root directory, the safest way to delete the proper subdirectory is to provide the full path name.

Note that DOS won't let you delete a directory that contains files. You can delete any directory on your disk except the root directory. That one has to stay.

Using The Keyboard With DOS 5

Most of the work you do with DOS requires keyboard interaction. In addition to commands like DIR and TYPE, your computer also responds to number of command keys. Press a single key, and DOS responds in a particular matter.

The most well-known command key is Enter. Press it to activate the current command you've typed at the DOS prompt. There are about two dozen more commands keys, though not all are so obvious. For example, DOS supports seven of the programmable function keys for quick editing, plus numerous control keys for performing special duties. Let's take a quick look at these special command keys, review what they do, and how to use them.

FUNCTION KEYS FOR FASTER INPUT

DOS uses function keys F1 through F7 for command-line input. One of the best-known DOS function key shortcuts is F3. Press it and the last command you issued is repeated at the DOS prompt.

The majority of the function keys use a limited memory segment called the "template" or "buffer." This buffer holds the last command you issued to DOS. If you have yet to issue a command at the DOS prompt, the buffer will be empty. The buffer may also be empty if some other activity—like running an applications program —has cleared it. Note that the following keys, and in fact all other DOS command keys, are also used in the DEBUG and EDLIN programs.

Here's all of the DOS function key commands:

F1 Enters the character stored in the buffer that is at the same position as the cursor. For example, suppose the buffer contains the line "TYPE A." The cursor is currently at the sixth position. Pressing the F1 key will enter "A" into the current DOS prompt. You can experiment with the F1 key by pressing it repeatedly. One character at a time, DOS will re-enter the previous command line.

F2 c Copies all characters from the buffer from the cursor position to the character "c" in the new command line. To use this command key, press F2, then press a letter you know is part of the buffer (like "A" in "TYPE A"). You can use upper or lower case; DOS won't care. In response, DOS will copy the command line from the buffer up to, but NOT including, the first occurrence of the letter you typed (F2 A will display "TYPE," followed by a space). This command is handy when you want to re-enter the same basic command and provide a unique filename.

F3 Copies all characters from the current cursor position to the end of the buffer. Usually, you use F3 to repeat the entire command line. Suppose you enter "DIR *.EXE" at the DOS prompt. To re-execute this command, press F3 again; DIR *.EXE is re-displayed in the DOS prompt. Press the Enter key to run the command. You can also use F3 to insert just a portion of the command line from the buffer. DOS will pick up the contents of the buffer starting at the current cursor position.

F4 c Like the F2 key, but forces DOS to copy the characters from the buffer after character "c." To actually enter the text into the current command line, you need to press F3.

F5 Erases what you've written so far and starts a new command line. You don't have to press the Backspace key to erase a line of text if you find a command has been entered incorrectly. Just press F5 (a @ symbol appears and the cursor is moved down a line). Type in the new command line, and press Enter.

F6 The F6 key inserts a ^Z character. This is the same as pressing Ctrl-Z, and is included as a shortcut. The ^Z should be added in text files that are used by DOS to denote the end of a file. (While current versions of DOS rely on other methods to determine the end of a file, it's still a good practice.)

F7 Inserts an ASCII 0 NULL character into the line. This appears as ^@, and is the same as typing Ctrl-@. The NULL character is sometimes used in entering data into the DOS EDLIN program and has little use when entering commands at the DOS prompt.

ADDITIONAL EDITING KEYS FOR THE BUFFER

In addition to function keys F1 through F7, DOS reserves the Ins (insert) and Del (delete) keys for special purposes when using the command line buffer. These keys are a bit unusual in the way they work, and in some respects, their syntax reduces their effectiveness. But they can come in handy when used properly:

Ins Pressing the Ins key "freezes" the contents of the buffer. You can then add characters to the current command line, and use function keys F1 through F4 without regard to where the cursor is currently resting. For example, press Ins at the beginning of a new command line. Now type in any text. Press F3. Instead of inserting the characters from the buffer starting at the current cursor position, DOS inserts all of the buffer. You can use the other function keys in a similar manner. Experiment with this key to discover its hidden talents and possibilities.

Del Pressing the Del key removes a character from the buffer. Example: Suppose the buffer contains the line "This is a test" (never mind that it isn't an acceptable DOS command). On a new command line, press F1 four times, and DOS displays "This." Press Del a total of five times (to delete "is a," with leading space), then press the F3 key. The resulting command line will read "This test."

> **A new feature to DOS 5 is the DOSKEY command. DOSKEY is a program that stores and recalls commands you type at the DOS prompt.**

DOS CONTROL KEYS

Control keys let you manipulate DOS and its functions in special ways. All control keys use the Ctrl key as a modifier, combined with a letter key, such as P or S:

Ctrl-C At a command line, Ctrl- C cancels the command and returns you to the DOS prompt. When a program or batch file is running, Ctrl-C attempts to terminate the program or batch, and return you to the DOS prompt.

Ctrl-P Copies characters printed on the screen (by you or DOS) as they appear, and sends them to the printer (usually the one connected to the LPT1 port). The Ctrl-P method is one quick way to print a directory listing or contents of a text file. Ctrl-PrtSc (print screen) is the same as Ctrl-P on most computers.

Ctrl-S Stops the screen display. Useful when viewing a large directory listing or text document. Note: Ctrl-S doesn't always have an immediate effect, depending on the size of the listing or document, whether or not you have BREAK=ON included in your CONFIG.SYS file (use BREAK=ON) to force your computer to watch for keyboard entry more often. DOS may ignore your request until it's finished displaying text. To continue the text display, press any other key. Ctrl-Num lock is the same as Ctrl-S.

Ctrl-Brk The Ctrl-Break keys perform the same basic function as Ctrl-C, but can have more effect when terminating stubborn programs. If Ctrl-C doesn't work, try Ctrl-Break.

Ctrl-H Same as the Tab key. Moves the cursor to the next tab position on the screen.

Ctrl-I Same as Backspace key. Backs up the cursor one space and deletes the character there, if any.

Faster Access WithDOSKEY

A new feature to DOS 5 is the DOSKEY command. DOSKEY is a program that stores and recalls commands you type at the DOS prompt. It can also be used to build "macros," short scripts that combine several DOS commands.

USING DOSKEY

DOSKEY is a terminate-and-stay-resident (TSR) program, so once you run it, it stays loaded into memory until you turn your computer off. You can load DOSKEY into conventional memory, if you're using the DOS 5 LoadHigh Command, load the program into "high memory." This frees some of the conventional 640K of

RAM for other programs.

To load DOSKEY into conventional memory, type:

DOSKEY

To load DOSKEY into high memory, type:

LOADHIGH DOSKEY or
LH DOSKEY

If you plan on making heavy use of DOSKEY, you should include these command lines in your AUTOEXEC.BAT file so the program is always run when your computer starts.

The DOSKEY command understands a small number of optional command-line switches. You add these switches after the "DOSKEY" command on the DOS command line. These switches are:

- **/reinstall**—Normally, when typing DOSKEY again after loading the program once, DOS reports that it's already in memory. You can reinstall additional copies of DOSKEY in memory with this command. Example: **DOSKEY /reinstall**.
- **/bufsize**—Allocates more memory to store the keystrokes remembered by DOSKEY. The default is 512 bytes; the minimum is 256 bytes. Generally, a buffer of 1024 to 2048 bytes should be more than enough. Example: **DOSKEY /bufsize=1024**.
- **/macros**—Displays a list of the macros you've created with DOSKEY. The macro feature of DOSKEY is detailed later. Example: **DOSKEY /macros**.
- **/history**—Displays a history of the previously entered commands stored in memory. Example: **DOSKEY /history**.
- **/insert**—Specifies that you want command text to be added to any old text on the line. Example: **DOSKEY /insert**.
- **/overstrike**—Specifies that you want new text to replace old text on the line. The /overstrike setting is the default. Example: **DOSKEY / overstrike**.

Two of the DOSKEY command switches can also be entered in shortform, to save you typing:

Long Form	Short Form
/macros	/m
/history	/h

MEMORIZING COMMANDS

With DOSKEY installed, it will memorize commands you type at the DOS prompt. The commands you type are stored in a special part of memory we'll call the DOSKEY buffer. The buffer is limited (the default is 512 bytes, or 512 characters), so as new commands are entered, old ones are deleted.

RECALLING COMMANDS

Recalling commands is easy: Just press any of the following keys (most keys will cycle through a series of commands if you press them repeatedly):

Up arrow Recalls the previous DOS command in the DOSKEY buffer.

Down arrow Recalls the next DOS command in the DOSKEY buffer.

Page up Recalls the oldest command in the DOSKEY buffer.

Page down Recalls the most recent command in the DOSKEY buffer.

Any command displayed by DOSKEY can be edited, using the same function and editing keys described in the previous section, "Using the Keyboard with DOS 5," plus several additional ones:

F1 Copies a character from the buffer to command line.

F2 Searches forward in buffer to next key after pressing F2; inserts text onto command line from that character on.

F3 Copies remainder of buffer to command line.

F4 Deletes characters starting with first character, up to a character you specify.

F5 Copies the current command into the buffer and clears the command line.

F6 Inserts a ^Z character.

F7 Displays all commands stored in the DOSKEY buffer, with associated numbers.

Alt+*F7* Deletes all commands in the DOSKEY buffer.

F8 Searches DOSKEY buffer for a command you want to display; to use, press F8, type first characters of command until command you want is displayed.

F9 Prompts for number of command to execute; show numbers with F7 key.

Alt+*F10* Deletes all macro definitions.

Left arrow Moves cursor one character to the left.

Right arrow Moves cursor one character to the right.

Ctrl+left Moves cursor one word to the left.

Ctrl+right Moves cursor one word to the right.

Home Moves cursor to start of line.

End Moves cursor to end of line.

Esc Clears command from line.

CREATING DOSKEY

Perhaps the most powerful DOSKEY feature is its ability to memorize a series of commands, and play them back very quickly. To create a macro, type:

DOSKEY

```
macroname=instructions
```

Provide a unique name for the macro, and type the commands you want to execute.

If you want to execute two or more commands, separate them with a **$** or **$t** symbol. This tells DOSKEY that you want to run the commands separately, but one right after the other, in order. For example to type the contents of the AUTOEXEC.BAT and CONFIG.SYS commands, you might create the following DOSKEY macro:

```
DOSKEY SEE FILES=TYPE \AUTOEXEC.BAT $t TYPE \CONFIG.SYS
```

Then, to execute the macro, just type SEEFILES. (Note: DOSKEY doesn't need to be installed in memory already when you assign a macro. If it's not installed, DOS will do it for you.)

Use the $1 through $9 commands in a DOSKEY macro definition to define a "replaceable parameter." You might use this, for example, to compile the TYPE and MORE commands, and also allow you to enter a different filename each time. Because the MORE command is used with the "pip" character (|), you must replace it with $B or $b in the DOSKEY macro command definition.

```
DOSKEY TYPEMORE=TYPE $1 $b MORE
```

The $1 is a placeholder for the filename you'll type when you run the TYPEMORE macro. The $b serves as the | character. To use the macro, type:

```
TYPEMORE filename
```

In place of filename type the name of the file you want to TYPE. If the text extends beyond one screen, DOS will pause at the bottom and display a -More- prompt. Press Enter to see another page of the text, until the file is over (you can press Ctrl+C to return to the DOS prompt if you don't want to view all of the file).

The equivalent DOS command is:

```
TYPE filename |MORE
```

The DOSKEY macro "language" uses a number of other special characters. Refer to the DOSKEY reference in the DOS User's Manual for full details.

USING MACROS IN PLACE OF BATCH FILES

You can see that DOSKEY macros can easily be used to take the place of batch files. You can define the macros you want to use in your AUTOEXEC.BAT file, as in:

```
DOSKEY macro1=...
DOSKEY macro2=...
DOSKEY macro3=...
```

and so forth. There are several advantages of using DOSKEY over batch files:

- DOSKEY macros generally execute faster than batch files.
- All DOSKEY macros are stored in memory, rather than separate files on disk. This reduces disk clutter.
- Because DOSKEY macros are stored on disk, you don't have to worry about "batch file not found" messages that can occur when you change disks or drives during a batch process.

While the DOSKEY command does consume some memory, especially if you load lots of macros, the overall savings generally outweigh the disadvantages. Of course, DOSKEY macros don't compare with "intelligent" batch files. These are batch programs that make decisions based on user input or the state of the computer.

If you forget the name of your macros, type:

```
DOSKEY /macros
```

at the DOS prompt and a list of macros, and their definitions appears. If your list is long, you may want to create a paper copy, or a permanent file. You can "re-direct" the screen display of the macro listing to a file by typing:

```
DOSKEY /macros > mymacros.fil
```

This saves a listing of all your macros in a file called MYMACROS.FIL. You can print this file, or store it away for safe keeping.

Using The DOS ATTRIB Command

The Attrib command actually isn't new with DOS 5, having been available since DOS version 3.0 or later. However, it's still one of the least understood "special" commands of DOS, and deserves some attention. ATTRIB lets you change certain traits of any file on your disks. These attributes include:

- Setting the read-only "flag," used to lock a file and prevent it from being over-written or erased, and
- Changing the archive status of the file, which determines if the file will be copied when backing up a hard disk.

Attrib is an external DOS command. This means that while Attrib is part of MS-DOS, the actual command is really a program you execute at the DOS command prompt. To use Attrib you must have ATTRIB.COM on your disk, and in the current directory. If you type "Attrib" at the DOS prompt and nothing happens (other than an error message), it means that your computer can't find the ATTRIB.COM command.

CHANGING THE READ-ONLY ATTRIBUTE

You know you can prevent accidental erasure of files on a floppy disk by placing a piece of tape over the write-protect notch on the side of the disk. With the disk write-protected, you can access. or read, the files contained on it, but you can't alter or erase them.

Write-protecting a disk is a good way to preserve all of the files on a floppy diskette. But what if you want to be able to lock out only some of the files from erasure or alteration? Or what if these files are on a hard disk, which lacks a write- protect notch?

All files created in DOS have four invisible attributes. One of these attributes is the read-only status of the file. If the read-only status is set to ON, then the file is write-protected and can't be erased or edited. Normally, the read-only status (or flag) is set to OFF, so that files can be freely deleted and altered.

The main function of the Attrib command is to turn the read- only flag on and off. To turn read-only ON (and lock the file from erasure), type:

ATTRIB +r filename

Replace filename with the actual name of the file you want to protect. To turn read-only OFF (and unlock the file from erasure), type:

ATTRIB -r filename

If you're not sure of the current status of the read-only attribute for the files on your disk, type:

ATTRIB *.*

This displays a directory of all files on the current disk (and in the current directory), as shown in Figure ##. An R beside any file means that the read-only attribute is ON. That file can't be erased or edited. An A beside any file means that the archive status for that file is currently ON. We'll get to the archive status in a bit.

Of course, you can also view the current attribute settings for any file by typing:

ATTRIB filename

Again, replace filename with the name of the file you want to check.

The Attrib command accepts the standard DOS wildcards, * and ?, so you can display only those files that fit the criteria you are looking for, such as:

ATTRIB *.doc All files with the .doc extension.

ATTRIB report?.wks REPORT1.WKS, REPORT2.WKS, etc.

CHANGING THE ARCHIVE STATUS

When you create or edit a file, DOS automatically sets the archive status for that file to ON. Those files with the ON status will be archived when you back up the hard drive (or copy files with the Xcopy command). When the backup is finished, DOS will turn the archive status to OFF, so that those files won't be included in the next backup—unless, of course, they are edited in the mean time.

You can easily set the archive status ON or OFF for any file, or group of files. This lets you more easily skip files during a backup, or include files that might otherwise be passed over. To set the archive status to ON for any file, type:

ATTRIB +a filename

Replace filename with the actual name of the file you want. To turn the archive status OFF (and have the file skipped during Backup), type:

ATTRIB -a filename

Type ATTRIB. *.* to view the read-only and archive attributes for all files on the current drive and directory. Note that the -a and +a archive options are available only in MS- DOS and PC-DOS versions 3.2 or later.

USING PATHS WITH ATTRIB

If you have a hard disk, the ATTRIB.COM program is likely in a DOS subdirectory, with the other important files that make up the MS-DOS operating system. When using Attrib, you may need to indicate a path for the file (or files) you want to modify. That's easy to do; merely provide the drive and/or directory path along with the file name. Here's an example:

ATTRIB +r C:\*.*
ATTRIB -r C:\CONFIG.SYS
ATTR-r C:\AUTOEXEC.BAT
ATTRI+a C:\LOTUS\*.WK1

This sequence of four Attrib commands starts by setting the read-only attribute for all files in the root directory of the drive to ON (no edit/ erase). The next two Attrib commands turn read-only to OFF for just the CONFIG.SYS and AUTOEXEC.BAT files, both of which are located on the C: drive and in the root directory. Finally, the last Attrib command sets the archive status for all files in the LOTUS subdirectory, and that have the .WK1 file extension.

Using DOS 5 DIR

If there's one command DOS users know by heart, it's DIR, for displaying a list of files on the current disk or DIRectory. In versions previous to DOS 5, you often had to combine the DIR command with other DOS functions to perform advanced housekeeping chores. You could sort the file names in a directory, for instance, but you had to combine DIR with the SORT command, being mindful of the proper syntax and limitations. Many users developed complex batch files for such chores, rather than remember the required keystrokes each time. Or, more often, users just avoided such complex commands altogether.

With DOS 5, the DIR command now includes the ability to sort files, in no fewer than 10 ways. In addition, the DOS 5 DIR command lets you specify directory listing on more than just a file name pattern. You can now display only directories, only files (and not directories), only read-only files, only files that are reserved for system use, and more.

DIR REVISITED

The DIR command can be used by itself, or with optional command-line parameters. Typing:

DIR

at the DOS prompt displays a list of files on the current disk or directory. You can fine-tune what the DIR command shows with several options (You can usually combine two or more of these options to create an almost unlimited number of file list possibilities.):

- Type DIR, followed by a disk letter and colon, and DOS displays the contents of the indicated drive (example: **DIR B:**).
- Type DIR, followed by a directory path, and DOS displays the contents of the indicated directory (example: **DIR \WP51\DOCS**).
- Type DIR and the name of a file, and DOS will display only that file. This is helpful if you want to be sure a file is located on a particular disk or directory (example **DIR FILENAME.EXT**).
- Type DIR, and a file name pattern, using either one or both of DOS's wildcard characters: * and ?. (Examples: **DIR *.*** displays all files, and is the same as typing DIR alone; **DIR *.EXE** displays only those files with the EXE file extension; **DIR REPORT?.DOC** displays only those files with a pattern such as REPORT1.DOC, REPORT2.DOC, etc.)
- Type DIR with a /W parameter to display a "wide" listing. Displays files five across, instead of just one. (Example: **DIR /W**).
- Type DIR with a /P parameter to pause the listing every 22 items. It's helpful if the directory contains more than 22 files. (Example: **DIR /P**).

DISPLAY BY FILE ATTRIBUTES

All files include three parts: a file name, the actual contents of the file, and a special byte called the **attribute byte** that contains useful information about the file. These attributes indicate if the file is for system use, is hidden from normal DIRectory listings, has been recently backed up ("archived"), and/or is marked for read-only (can't erase or write over).

Before DOS 5, there was no direct way to display only those files that matched certain attributes. For example, you couldn't display all those files that were recently backed up, or those files that were set to read only. The new DIR /A parameter in DOS 5 provides such a feature. To use the /A parameter, type

DIR /A:

and follow it with the attribute option you want (the colon following the /A is actually optional).

You have a choice of the following options parameters. Feel free to use more than one option, but remember to separate each with a blank space.

/A Option	What It Does
h	Hidden files.
-h	Files other than hidden.
s	System files.
-s	Files other than system.
d	Directories.
-d	No directories; files only.
a	Files set for backup (archive flat ON).
-a	Files recently backed up (archive flag OFF).
r	Read-only.
-a	Files other than read-only.

For example, to display only the subdirectories on a disk or inside another directory, type

DIR /A:d.

Or, to display all files that have been recently backed up, type

DIR /A:-a.

Note that you can only combine dissimilar option parameters at one time. For example, you can't combine r and -r in the same command. You can, however, combine r and -a, -a and -r, and so forth. This rule also applies to the sort option, detailed next.

SETTING A SORT ORDER

Normally, the DIR command displays the files as they physically occur in the directory of the disk. As you add files, new ones are placed at the end. (Curiously, if you delete a file somewhere in the middle of the list, the next file you create will take the place of the deleted one. This is intentional; when DOS deleted the file it opened a "slot" in the directory list. A file created subsequently is placed into this slot.)

There may be many occasions when you want the directory listing to appear in some orderly fashion. DOS 5 offers a sort option with the DIR command, and you can sort in any of 10 different ways. (You can also combine two or more of the sort parameters, for even more variations.)

The sort option is similar to the archive option, detailed above. Type DIR, followed by /O: (the colon is optional, but recommended for readability). Here are the available option parameters:

/O Option	What It Does
n	Sorts by name, A-Z.
-n	Sorts by name, Z-A.
e	Sorts by extension, A-Z.
-e	Sorts by extension, Z-A.
d	Sorts by date, old to new.
-d	Sorts by date, new to old.
s	Sorts by increasing size.
-s	Sorts by decreasing size.
g	Groups directories first.
-g	Groups directories last.

NEW DIR SWITCHES

Both the archive and sort options are commonly used with parameters. The DOS 5 DIR command also includes three new and useful command options that are used without additional parameters. These are /S, /B, and /L.

- /S—Lists every occurrence of a specified file. The list is limited to a specified directory and its subdirectories. If you want to find a file anywhere on your disk, and you're not sure where it is, use the /S option and specify the root directory. (Example **DIR /S C:\MYFILE.DOC.**)
- /B—Lists each directory and file on a single line. This command is used to over-ride the /W option, and is important if you've used the DIRCMD command, as detailed below.
- /L—Lists files and directories in lower-case.

SETTING A DEFAULT DIR COMMAND

Unlike earlier versions of DOS, you can set a user "default" for the DIR command in DOS 5. For example, you can type DIR at the DOS prompt, and rather than the standard DIRectory, DOS displays a list of just document files, or displays the list in wide format. The actual display is left up to you. To set a new default for the DOS command, include a SET statement in your AUTOEXEC.BAT file, like this:

```
SET DIRCMD=/W
```

This sets the default for the DIR command to display wide files whenever you type DIR at the DOS prompt, and is equivalent to the command **DIR /W** (now you know why they added the /B option, in case you want to display the files in the standard single-column format).

Or, if you want to display only files, and no directories, enter:

```
SET DIRCMD=/A:-d
```

Note that you can set and reset the default DIR command any time while in DOS, not just in the AUTOEXEC.BAT file. At the DOS prompt, type

```
SET DIRCMD=
```

and follow it with any options you want.

- To clear all user defaults (and use the standard DIR settings), enter

```
SET DIRCMD=
```

without any options.

- To view the current DIRCMD settings (as well as other parameters established with the SET command), type

```
SET
```

at the DOS prompt.

If you use the SET DIRCMD only at the DOS prompt (and don't put it into the AUTOEXEC.BAT file), the new defaults will be lost when you reset your computer.

Secrets Of The Copy Command

The COPY command is the "Xerox machine" of the DOS world, allowing you to make individual copies of one or more files on your disk.

Undoubtedly, you've already used the COPY command, and you probably know how to make simple copies from one disk to another. But you may be unaware of the special options you can use with the COPY command. Let's take a look at some of the lesser known features of the COPY command.

THE BASIC COPY COMMAND

The COPY command is available in all versions of DOS, including DOS 5, and is internal to the operating system. That is, there's no standalone executable program for the DOS command. You need only to type the name of the command, the file you want to copy, and the desired destination, such as:

```
COPY myfile B:
```

This copies the file "myfile," which resides in the current disk and directory, to the disk in drive B:. In this case, the name of the copied file is the same as the original. If you want to give the copy a new name, type:

```
COPY myfile B:newname
```

This makes a copy of "myfile" in drive B:, and names it "newname." In DOS terminology, "myfile" is the **source** and "newname" is the **target**.

If you aren't in the directory that contains the source file, you can indicate the drive and path, as needed.

```
COPY C:\memos\myfile D:\letters\myfile
```

This copies the file "myfile," which is in drive C within the memos directory, and places it in drive D, under the letters directory. You can, of course, provide a new name for the target file, such as

D:\letters\newname.

DOS allows you to use wildcards when copying files. This lets you copy more than one file at a time. Here are some examples:

COPY *.* Copies all files.

COPY *.EXE Copies just program files with an EXE file extension.

COPY BUDGET? Copies all files that start with "BUDGET" and end with a single character, like "BUDGET1" or "BUDGET2."

"Copying" a File From the Keyboard

An unusual application of the COPY command is to create a short text file directly from the DOS prompt using the keyboard for data input. You might use this method to create a simple AUTOEXEC.BAT batch file, or CONFIG.SYS configuration file for your computer.

To create a file from the keyboard, type:

```
COPY CON filename
```

In place of "filename" provide your own unique name for the file, such as CONFIG.SYS or STARTUP.BAT. Press Enter and DOS will seem to go to sleep. You won't see the familiar DOS prompt.

Now just start typing. End each line with a hard return. After the last line, press the Enter key one more time, then press the F6 function key. This adds a ^Z (control-Z) end-of-file code, which DOS needs when it plays back the file. Press Enter one last time. If everything worked properly, DOS will report that one file was copied.

While the COPY command is a relatively painless way of creating simple text-only documents, it's obviously not a method you'll want to use if you are building a large file, or want to edit the contents of an existing file. Use a word processor or text editor instead.

Redirecting File Output With Copy

The COPY CON techniques is used to capture your keystrokes and store them in a file. In a comparable manner, you can use COPY with DOS to send a disk file to a printer. The technique is easy. The following example shows how to print the file "filename" on a printer connected to the LPT1 parallel printer port:

```
COPY filename LPT1
```

You can substitute LPT1 for another active printer port installed in your computer, including any other parallel port (such as LPT2), or a serial port (COM1, COM2, etc.).

Before you issue a copy-to-printer command, be absolutely sure the printer is turned on, is on-line, and is connected properly. Otherwise, DOS may hang trying to print the file. Should this happen, you can usually return to the DOS prompt by pressing Ctrl-C, or Ctrl-Break.

Combining Copied Files

From time to time, you may wish to combine two or more files into one file. A typical application is chaining a series of text files to make one larger file. The COPY command can be used for this, too.

```
COPY file1 + file2 + file3 newfile
```

This copies the files "file1," file2," and "file3" and creates a new target file named "newfile." The command line is shown with spaces between the plus signs and the file names, but DOS doesn't require this. You may find it easier to type the command line without spaces.

Unless you tell it otherwise, DOS assumes the files you are combining are ASCII, and contain just printable text. However, if you want to combine binary files, you need to use the /B switch. Once you use the /B switch in a single COPY command, DOS assumes the remainder of the files are binary as well. If necessary, you can combine ASCII and binary files into one file by using a composite of /B (for binary) and /A (for ASCII) switches. The order in which you enter these switches can be important, so use this feature with care. Here's an example:

```
COPY file1/B + file2 + file3/A newfile
```

The files "file1" and "file2" are binary, and "file3" is ASCII. All three files are combined into a single file, named "newfile." The /B turns on the binary switch for the first and second files. The /A resets the switch for the third file.

Using Help

If you get stuck in DOS 5 and need information on using a particular command, help is but a keystroke or two away. At the DOS prompt, merely type:

```
HELP
```

and the name of the command you want help with. For example, to review the help on the DIR command, and see a list of all the available options, type:

```
HELP DIR
```

You can also review the available help topics by typing HELP by itself on the DOS command line. Table 1 includes a list of the major help topics, and the short "one-line" review provided:

The HELP topics are detailed in a file named DOSHELP.HLP, which is a standard text document. You can modify this file to add, remove, or edit entries. (Just be sure to save it as a text- only file.) In fact, a number of third-party DOS utilities, like Norton Utilities, do this automatically during installation.

You might want to edit the DOSHELP.HLP file to customize the help provided to users in your office or home, for example, or to add help for a custom utility you wrote. ■

The Major Help Topics in DOS 5.0 and What Each Function Does

TOPIC	FUNCTION
APPEND	Allows programs to open data files in specified directories as if they were in the current directory.
ASSIGN	Redirects requests for disk operations on one drive to a different drive.
ATTRIB	Displays or changes file attributes.
BACKUP	Backs up one or more files from one disk to another.
CD(Also CHDIR)	Displays the name of or changes the current directory.
CHCP	Displays or sets the active code page number.
CHKDSK	Checks a disk and displays a status report.
CLS	Clears the screen.
COMMAND	Starts a new instance of the MS-DOS command interpreter.
COMP	Compares the contents of two files or sets of files.
COPY	Copies one or more files to another location.
CTTY	Changes the terminal device used to control your system.
DATE	Displays or sets the date.
DEBUG	Runs Debug, a program testing and editing tool.
DEL	Deletes one or more files.
DIR	Displays a list of files and subdirectories in a directory.
DISKCOMP	Compares the contents of two floppy disks.
DISKCOPY	Copies the contents of one floppy disk to another.
DOSKEY	Edits command lines, recalls MS-DOS commands, and creates macros.
DOSSHELL	Starts MS-DOS Shell.
ECHO	Displays messages, or turns command echoing on or off.
EDIT	Starts MS-DOS Editor, which creates and changes ASCII files.
EDLIN	Starts Edlin, a line-oriented text editor.
EMM386	Turns on or off EMM386 expanded memory support.
ERASE	Deletes one or more files.
EXIT	Quits the COMMAND.COM program (command interpreter).
EXPAND	Expands one or more compressed files.
FASTOPEN	Decreases the amount of time needed to open frequently used files and directories.
FC	Compares two files and displays the differences between them.
FDISK	Configures a hard disk for use with MS-DOS.
FIND	Searches for a text string in a file or files.
FORMAT	Formats a disk for use with MS-DOS.
GOTO	Directs MS-DOS to a labelled line in a batch program.
GRAFTABL	Enables MS-DOS to display an extended character set in graphics mode.
GRAPHICS	Loads a program that can print graphics.

TOPIC	FUNCTION
HELP	Provides Help information for MS-DOS commands.
JOIN	Joins a disk drive to a directory on another drive.
KEYB	Configures a keyboard for a specific language.
LABEL	Creates, changes, or deletes the volume label of a disk.
LH (Also LoadHigh)	Loads a program into the upper memory area.
LOADFIX	Loads a program above the first 64K of memory, and runs the program.
MD (Also MKDIR)	Creates a directory.
MEM	Displays the amount of used and free memory in your system.
MIRROR	Records information about one or more disks.
MODE	Configures a system device.
NLSFUNC	Loads country-specific information.
PATH	Displays or sets a search path for executable files.
PRINT	Prints a text file while you are using other MS-DOS commands.
PROMPT	Changes the MS-DOS command prompt.
QBASIC	Starts the MS-DOS QBasic programming environment.
RD (Also RMDIR)	Removes a directory.
RECOVER	Recovers readable information from a bad or defective disk.
REN (or RENAME)	Renames a file or files.
REPLACE	Replaces files.
RESTORE	Restores files that were backed up by using the BACKUP command.
SET	Displays, sets, or removes MS-DOS environment variables.
SETVER	Sets the version number that MS-DOS reports to a program.
SHARE	Installs file-sharing and locking capabilities on your hard disk.
SORT	Sorts input.
SUBST	Associates a path with a drive letter.
TIME	Displays or sets the system time.
TREE	Graphically displays the directory structure of a drive or path.
TYPE	Displays the contents of a text file.
UNDELETE	Recovers files that have been deleted.
UNFORMAT	Recovers files after an accidental disk format.
VER	Displays the MS-DOS version.
VERIFY	Tells MS-DOS whether to verify that your files are written correctly to a disk.
VOL	Displays a disk volume label and serial number.
XCOPY	Copies files (except hidden and system files) and directory trees.

Quantum Passport XL 105

If transportability is more critical than price, check out this SCSI 105Mb portable. Not only is it reliable—its performance is outstanding.

The Quantum Passport XL removable hard drive provides a new level of performance in a removable media system, but you'll also pay a premium price for the speed and portability. A 105MByte external system lists for $1,317. Each additional disk pack costs $629.

Removable disk drives have traditionally been used where data security is the primary concern. Drives can be locked away to prevent unauthorized access to the data stored there and provide a means of transferring large quantities of data between two different locations.

Quantum selected the Small Computer Systems Interface (SCSI) to support the high data rates of disk-intensive applications. Combining SCSI with the latest Winchester drives gives you twice the performance of most AT-class fixed hard disks, with access times of 9 ms, seek times of 17 ms and sustained data transfer rates of 1.4 MB per second.

Installation requires very little work. After opening the case, you'll need to locate an empty 16-bit slot (the kind with 2 connectors on the motherboard) to install the SCSI card in. Quantum sells both AT- and PS/2-compatible interface cards. Once the SCSI adapter has been installed in the computer, connect the 6-foot cable to the external chassis and the hardware's ready to go, although if you already have a hard-disk controller installed in your system, you'll probably have to change the address on the SCSI card. A pair of needle nose pliers will come in handy to move the jumper blocks.

Software installation requires DOS 3.0 or higher. Quantum supports DOS, OS/2, and XENIX/UNIX with custom drivers. You'll have to format the disk before you use it for the first time, but total time to prepare the 105MByte drive is less than 3 minutes. The INSTALL program also modifies your CONFIG.SYS file to add the SCSI driver.

Each Passport XL disk cartridge has two switches on the back. One allows you to write-protect the cartridge and the other configures the disk as the primary boot device. Setting the boot switch to "ON" changes the sequence of the hard drives in your system: The Passport XL and the original drive essentially swap positions.

If you happen to have an original IBM-AT with system ROMs dated 1/01/84, you'll need to run the ATPLUS program. As it turns out, DOS 3.1 or greater modifies the IBMBIO.SYS file during boot-up for proper built-in hard drive operation. The only problem is that this prevents access to the Passport XL drive. The version of ATPLUS provided by Quantum checks the operating system files on a bootable diskette or built-in hard drive. If necessary, it will modify these files to work correctly with the Passport XL drive.

The INNKEEPR utility program provides the means to lock/unlock and eject the Passport XL cartridge from the DOS or OS/2 command line, while WINKEEPR provides the *Windows* 3.0 user the same capability from the *Windows* environment.

A 9-volt NiCad battery provides enough power to eject the cartridge in the event of a power failure. If you want to prevent removal of the drive when the system is turned off simply leave out the battery.

The manual we reviewed was a preliminary draft copy and was missing several important features. Every good manual should have an index to make finding information easy. This one had a table of contents but no index. Another useful item would have been a chart of common configurations, something that would tell you how to configure the interface card if you have one hard disk controller and a VGA card, for example. The manual does have a step-by-step troubleshooting section that makes diagnosing problems much easier. This section leads you through the normal steps of checking things like power and cabling, and making sure the interface card is seated properly.

Quantum has taken an increasingly common approach to technical support: a 900 number with a flat $5.00 per call charge. On the one hand, this is expensive; on the other, it eliminates long distance charges spent waiting on hold. An 800 number would, of course, have been preferable. Customer support is available from 7:00 A.M. to 5:00 P.M Pacific time with minimal waiting. The standard product carries a two-year warranty on parts and labor. Quantum also maintains an electronic BBS for software updates.

If you're in need of a removable disk system, the Quantum Passport XL would make a good choice. While it can't compete with an Iomega Bernoulli or Syquest-cartridge type product on price, it blows them away on performance.

Quantum Corporation
500 McCarthy Blvd.
Milpitas, CA 95035
(800) 624-5545

Prices:

105 MB Cartridge	$449
Internal Chassis	$359
External Chassis	$469
AT-SCSI Adapter	$219
Micro Channel Adapter	$329

Hard Disk Dictionary

Understanding the vocabulary of hard disk lore is the first step toward finding the right drive for your system.

Hard disk technologies have matured considerably since the early days of the IBM XT and its standard 10Mb hard disk drive. Capacity, quality, and reliability have risen enormously, and prices have fallen to the point where not owning a hard disk drive no longer makes economic sense. But before you add a first or second hard drive to an existing system, you have to know what the hardware and software issues are. To do this, you have to understand the vocabulary.

Access Time
The average amount of time between when a hard disk receives a command to retrieve data and when the data is fetched and delivered to the computer. Access time may or may not take into account settling time and rotational latency; if it does not, access time is primarily a measure of drive performance and does not reflect the true speed of the controller or interface.

Automatic Park
An automatic hard disk safety feature whereby the read/write heads of a hard disk drive are placed on a safe area of the disk surface when the drive is turned off.

Cache
A hardware- or software-driven system for temporarily storing data retrieved from a hard disk drive. The cache retains copies of the data most recently retrieved from the disk, either in a reserved portion of the computer's RAM, or in RAM located on the hard disk drive controller electronics. If the data stored in the cache is needed again, it is recovered from the cache instead of from the drive. This speeds up system operation, in some cases substantially.

Cluster
The smallest unit of storage space on a hard disk. All hard disks are divided into tracks, clusters, and sectors. Clusters are composed of one or more sectors. They vary in size with the capacity of disk and the type of computer used, but are typically 2K or 4K. The cluster size determines the minimum file size. All files recorded on the hard drive will be recorded in even 2K or 4K increments.

Controller
An electronic circuit that directs the operations of a hard disk drive. The controller is typically on a separate circuit board that plugs into an expansion slot on the computer's main motherboard.

Cylinder
A subdivision of hard disk storage area composed of all circular data tracks on all platter surfaces of the hard disk drive that share a common diameter as measured from the platter axis. On a two-platter hard disk (with four recording surfaces), the read/write heads will access four tracks at a time; these four tracks constitute one cylinder. A medium-capacity drive will typically have about 600 cylinders.

Data Encoding
Any one of several techniques used to record and later play back data from the platter surface of a hard disk drive. The encoding technique greatly influences the amount of data that can be stored on the disk, and also partly determines the reliability of the recording. Popular approaches include MFM, RLL, and ARLL.

ESDI (Enhanced Small Device Interface)
An interface standard developed by manufacturers for connecting a hard disk to a computer.

HardCard
Both a product name and a generic term for any hard-disk-on-a-card product that puts a complete hard disk drive and controller electronics on a board designed to fit into a standard computer expansion slot. HardCard is a trademark of Plus Development Corporation.

Head
That part of a hard disk drive that records data on the magnetic surface of the disk and reads it back again. Hard disk drives have two or more heads, one head for each recording surface. Because the heads in a hard disk drive are used both to record and play back computer data, they are referred to as read/write heads.

Head Gap
The distance between the read/write head and the surface of the diskplatter when the hard drive is in use. A cushion of air keeps the head floating above the surface of the drive, thereby preventing friction and wear.

High-Level Format
A formatting procedure carried out by the DOS FORMAT program. This operation creates the File Allocation Table and the Root Directory on a hard or floppy disk and can be used to transfer the COMMAND.COM and hidden system files to make a hard or floppy disk bootable.

File Allocation Table (FAT)
The portion of a disk (hard or floppy) that contains the disk's "roster" indicating which clusters are currently in use, which ones are available for new data, and which files the clusters belong to. The FAT is physically located at the disk's outer edge.

Interleave
The interspacing of sequential sectors belonging to any given file with other sectors. Interleave is expressed as a ratio. Hard drives typically have interleave ratios (also called interleave factors) of 1:1, 2:1, or 3:1. An interleave ratio of 2:1 means that the heads read from or write to every other physical sector and, consequently, that two disk revolutions are required to read all sectors in a given track. Interleave is used to control the speed of data flow from a hard drive to match it with the speed of a particular computer. An interleave of 1:1 is ideal.

Logical Drive
A drive recognized by the computer which does not physically exist as a separate hardware component. A single physical hard drive mechanism can be divided into one or more logical (or virtual) drives; for example drives C and D. The computer addresses these "drives" as distinct entities even though both use the same recording surfaces, read/write heads, controller, and so forth. A portion of the computer's memory can also be defined as a logical drive.

Low-Level Format
This basic formatting procedure divides up tracks on the disk surface into sectors. Sector interleave ratio is fixed during this operation and defective tracks are marked. A low-level format is performed using either a utility supplied with a new hard disk drive, a specialized commercialutility, or the DOS DEBUG program. A low-level format can take many hours to perform and should not be confused with high-level formatting.

MFM (Modified Frequency Modulation)
The recording technique used by most hard disk drives.

Microsecond
One millionth of a second.

Millisecond (ms)
One thousandth of a second; the unit of measurement for expressing hard disk average seek and access times.

Park
A process whereby the read/write heads of a hard disk drive are placed in a safe area on the surface of the disk. Parking, used when a computer is moved, or as a routine safety measure, ensures that little or no important data will be lost if the heads come into contact with the disk.

Partitioning
Setting aside physical portions of a hard disk as logical drives, or for use by different operating systems. All hard drives have at least one partition, which is the main partition all files are stored in.

Plated Media
A type of magnetic media used in hard disk drives where very thin layers of metal alloys are electroplated onto the disk platters to make a high-quality and durable recording surface about three millionths of an inch thick. Plated media offers an increase in data capacity and reliability over the older iron oxide coatings.

Platter
The actual disk or disks in a hard disk drive onto which the magnetic data-storage medium is deposited. These platters are generally made of aluminum and typically come in either 5.25-inch or 3.5-inch diameters. Most hard drives incorporate two or more platters.

RLL
An acronym for Run Length Limited recording, an enhanced recording technique that packs 25 to 50 percent more information on a given disksize than the older MFM technique. The ARLL (Advanced Run Length Limited) recording method packs up to 75 percent more data on a given hard disk.

Rotational Latency
A factor influencing the speed of average access time that is related to the disk's interleave ratio. A high

interleave ratio means that, on average, the disk will have to go through more revolutions before a desired cluster can be read than with a lower ratio, thereby increasing access time.

SCSI (Small Computer System Interface)
The systems-level interface used with many controllers to connect the computer to a hard disk drive. With this interface, as many as seven devices can be daisychained to a single SCSI host adapter. SCSI is not a controller itself, so all daisychained devices need their own controllers. The advantage of this, however, is that ST-506, SCSI, and ESDI drives and their controllers can be used in a single system.

Sector
Discrete physical "pie slices" of data storage area on the disk surface that together make up a single circular track. The standard sector size under DOS is 512 bytes. The number of sectors per track on a typical hard disk track can vary between 17 and 36.

Seek Time
The average time it takes for the read/write heads to move from one track to another track. Seek time is primarily a measure of the speed of the disk's actuator mechanism.

Servo Positioning
A system found in some hard disk drives (particularly the removable mass storage type) whereby special signals previously recorded on the disk aid in accurately positioning the drive heads for read/write operations.

Spindle Motor
The self-regulating electric motor that spins the hard disk's spindle and platters at 3,600 rpm. Spindle motors are always attached directly to the spindle although they may be located either inside or outside the sealed disk chamber.

Sputtering
A manufacturing process for depositing a magnetic medium on hard disk platters using a vacuum deposition technique. Sputtering produces the thinnest and hardest recording surfaces available on PC hard disk drives.

ST-506
The original hard disk interface standard, still in use today and employed by the majority of hard drives.

Stepper Motor Actuator
A type of read/write head positioning mechanism found in lower-end hard disk drives and in floppy disk drives. Stepper motor actuators are less expensive than voice coil actuators, but they are relatively slow, temperature sensitive, and less reliable.

Tracks
Rings of data storage area spaced in concentric circles on the surface of the disk platters. Tracks are divided into sectors, which are used to make up clusters.

Track-To-Track Seek Time
The time it takes for the read/write heads to move between adjacent tracks, measured in milliseconds.

Transfer Rate
The maximum amount of information, usually expressed in megabits per second (Mbits) or megahertz (MHz), that can be passed between the hard drive and computer in one second.

Throughput
The actual average amount of real data, expressed in megabits per second (Mbits) or megahertz (MHz), transferred from the hard drive through the controller to the computer.

Voice Coil Actuator
A type of positioning device found in high-end hard drives that quickly and accurately positions the read/write heads over the surface of the disk. The device is similar in principle to the voice coil that moves the cone in loud speakers. The other read/write head positioning mechanism is the stepper motor actuator.

Winchester Drive
An almost meaningless term often used as a synonym for any hard disk drive. In the 1960s, IBM developed a hard disk drive storage system that had 30Mb of storage on fixed disks and 30Mb on removable disk platters. This drive, dubbed the 30-30, soon became known as the "Winchester" after the famous 30-30 rifle.

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COMPARISON CHART: HARD DISK DRIVES 80Mb & GREATER

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Atasi Technology **Tomahawk 9220A**	half-height	PC/AT	3-1/2 inch	I	200Mb	16.5ms	3.8ms	10Mbit/sec.	50,000	—	9		IBM PC, AT, & compats.	$580
Model 519	full-height	RLL	5-1/4 inch	I	244.4Mb	20ms	5ms	5Mbit/sec.	40,000	—	35	shock mounts, auto actuator & spindle locks	IBM & compats.	700
Model 638	full-height	ESDI	5-1/4 inch	I	380Mb	18ms	3ms	10Mbit/sec.	40,000	—	38	auto actuator & spindle locks	IBM & compats.	900
Model 738	full-height	SCSI	5-1/4 inch	I	380Mb	18ms	3ms	1.5Mbit/sec.	40,000	—	38	auto actuator & spindle locks	IBM & compats.	900
CMS **Express F660E1 Express**	—	ESDI	—	I	701.8Mb	16ms	—	15Mbit/sec.	150,000	—	—		IBM PC & compats.	
K100A3-N	—	RLL	3-1/2 inch	I	100Mb	25ms	8ms	1.25 Mbit/sec.	20,000	—	5.7	embedded controller with universal kit	IBM AT & compats.	$709
K080A3-N	—	RLL	—	I	80Mb	25ms	8ms	1.25 Mbit/sec.	20,000	—	5.7			729
Silver Series K080S2	—	SCSI	3-1/2 inch	I	80Mb	25ms	10ms	2.5Mbit/sec.	50,000	—	9	1-yr. warranty	IBM PC & compats.	779
Silver Series K080A2	—	AT-40 pin, RLL	3-1/2 inch	I	80Mb	25ms	10ms	7.4Mbit/sec.	50,000	—	—	AT embedded controller, 1-yr. warranty	IBM AT & compats.	799
K080A2-N	—	RLL	3-1/2 inch	I	80Mb	25ms	—	7.4Mbit/sec.	—	—	9.2	embedded controller with universal kit	IBM AT & compats.	831
K080A2-AF	—	RLL	3-1/2 inch	I	80Mb	25ms	—	7.4Mbit/sec.	—	—	9.2	embedded controller with 16-bit adapter	IBM AT & compats.	879
Silver Series K120S2	—	SCSI	3-1/2 inch	I	120Mb	16ms	10ms	2.5Mbit/sec.	50,000	—	9	1-yr. warranty	IBM PC & compats.	979

I = Internal E = External All prices are U.S. suggested list. — = Information not available at press time. N/A = Not applicable

Make/Model	Drive Height	Drive Type	Form Factor	Mounting	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consumption (Watts)	Other Features	Works With	Price
K100A2-N	—	RLL	—	I	100Mb	18ms	5ms	6Mbit/sec.	30,000	—	10		IBM PC & compats.	999
K100A2-AF	—	RLL	—	I	100Mb	18ms	5ms	6Mbit/sec.	30,000	—	9.1		IBM AT & compats.	1,039
Presidential K080S1-M55N	—	SCSI-2	3-1/2 inch	I	80.7Mb	16ms	—	12Mbit/sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Models 55SX	1,039
Presidential K080S1-M80N	—	SCSI-2	3-1/2 inch	I	80.7Mb	16ms	—	12Mbit/sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Models 60, 65SX, & 80	1,039
K080M2-N	—	ST412/MFM	3-1/2 inch	I	80Mb	15ms	4ms	5Mbit/sec.	70,000	—	—	universal kit	IBM AT & compats.	1,051
K100S3-N	—	SCSI	3-1/2 inch	I	100Mb	25ms	8ms	1.25 Mbit/sec.	30,000	—	—		IBM PC, XT, AT, & compats.	1,051
Silver Series K120A2	—	AT-40 pin, RLL	3-1/2 inch	I	120Mb	25ms	10ms	7.4Mbit/sec.	50,000	—	—	AT embedded controller, 1-yr. warranty	IBM AT & compats.	1,091
K080M2-A	—	ST412/MFM	3-1/2 inch	I	80Mb	15ms	4ms	5Mbit/sec.	70,000	—	—	16-bit controller, universal kit	IBM AT & compats.	1,109
K120A2-AF	—	RLL	3-1/2 inch	I	120Mb	25ms	—	7.4Mbit/sec.	—	—	10.4	embedded controller with 16-bit adapter	IBM AT & compats.	1,119
Silver Series K180S2	—	SCSI	3-1/2 inch	I	180Mb	25ms	10ms	2.5Mbit/sec.	50,000	—	9	1-yr. warranty	IBM PC & compats.	1,171
K120A2-N	—	RLL	3-1/2 inch	I	120Mb	25ms	—	7.4Mbit/sec.	—	—	10.4	embedded controller with universal kit	IBM AT & compats.	1,191
Executive Series K80M25/30	—	MFM	3-1/2 inch	I	80Mb	15ms	4ms	5Mbit/sec.	20,000	—	9		IBM PS/2 Models 25, 30, & 30-386	1,259

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Presidential S080S1-N	—	SCSI-2	3-1/2 inch	I	80.7Mb	16ms	—	12Mbit/ sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Models 50Z & 70	1,299
Express K095E1	—	ESDI	3-1/2 inch	I	95Mb	20ms	—	10Mbit/ sec.	30,000	—	—		IBM PC & compats.	1,345
K160A2-N	—	RLL	3-1/2 inch	I	160Mb	25ms	—	7.4Mbit/ sec.	—	—	10.4	embedded controller with universal kit	IBM AT & compats.	1,351
K160A2-AF	—	RLL	3-1/2 inch	I	160Mb	25ms	—	7.4Mbit/ sec.	—	—	10.4	embedded controller with 16-bit adapter	IBM AT & compats.	1,379
Silver Series K180A2	—	AT-40 pin, RLL	3-1/2 inch	I	180Mb	25ms	10ms	7.4Mbit/ sec.	50,000	—	—	AT embedded controller, 1-yr. warranty	IBM AT & compats.	1,411
K200A2-N	—	RLL	—	I	200Mb	18ms	5ms	6Mbit/ sec.	30,000	—	10		IBM AT & compats.	1,451
K200A2-AF	—	RLL	—	I	200Mb	18ms	—	6Mbit/ sec.	30,000	—	10		IBM AT & compats.	1,499
PSExpress H130E1	—	ESDI	5-1/4 inch	I	130Mb	18ms	—	10Mbit/ sec.	30,000	—	—		IBM PS/2 & compats.	1,545
Express H140E1	—	ESDI	5-1/4 inch	I	140Mb	18ms	—	10Mbit/ sec.	30,000	—	—		IBM PC & compats.	1,559
Presidential K160S1-M55N	—	SCSI-2	3-1/2 inch	I	160Mb	16ms	—	12Mbit/ sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Model 55SX	1,559
Presidential K160S1-M80N	—	SCSI-2	3-1/2 inch	I	160Mb	16ms	—	12Mbit/ sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Model 60, 65SX, & 80	1,559
Presidential S160S1-N	—	SCSI-2	3-1/2 inch	I	160Mb	16ms	—	12Mbit/ sec.	45,000	—	—	self test diagnostics, automatic actuator lock	IBM PS/2 Model 50Z & 70	1,559
K200S-N	—	SCSI	3-1/2 inch	I	200Mb	—	5ms	1.5Mbit/ sec.	20,000	—	—		IBM PC, XT, AT, & compats.	1,611

Make/Model	Drive Height	Drive Type	Form Factor	Mounting	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consumption (Watts)	Other Features	Works With	Price
Plug 'n' Play K120M50z/70-P	—	micro channel	3-1/2 inch	I	120Mb	23ms	—	10.2 Mbit/sec.	45,000	—	—		IBM PS/2 Models 50z & 70	1,719
K200A3-N	—	RLL	3-1/2 inch	I	200Mb	19ms	5ms	1.5Mbit/sec.	20,000	—	5.5	embedded controller with universal kit	IBM AT & compats.	1,779
F115ESDI-T	—	ESDI	5-1/4 inch	I	115Mb	30ms	5ms	10Mbit/sec.	25,000	—	30		IBM PS/2 Models 60 & 80	1,899
Express H340E1	—	ESDI	5-1/4 inch	I	340Mb	15ms	—	15Mbit/sec.	150,000	—	—		IBM PC & compats.	2,495
PSExpress H330E1	—	ESDI	5-1/4 inch	I	330Mb	15ms	—	15Mbit/sec.	150,000	—	—		IBM PS/2 & compats.	2,545
Presidential K320S1-M55N	—	SCSI-2	3-1/2 inch	I	320Mb	12.5ms	—	16Mbit/sec.	150,000	—	—	64K read-ahead cache, self test diagnostics	IBM PS/2 Model 55SX	3,199
Presidential K320S1-M80N	—	SCSI-2	3-1/2 inch	I	320Mb	12.5ms	—	16Mbit/sec.	150,000	—	—	64K read-ahead cache, self test diagnostics	IBM PS/2 Models 60, 65SX, & 80	3,199
Presidential S320S1-N	—	SCSI-2	3-1/2 inch	I	320Mb	12.5ms	—	16Mbit/sec.	150,000	—	—	64K read-ahead cache, self test diagnostics	IBM PS/2 Models 50Z & 70	3,199
Prevail F325S0	—	SCSI	5-1/4 inch	I	340Mb	16.5ms	3.5ms	20Mbit/sec.	150,000	—	33	multiuser/network applications	IBM AT & compats.	3,495
Prevail E325S0	—	SCSI	—	E	340Mb	16.5ms	3.5ms	20Mbit/sec.	150,000	—	33	multiuser/network applications	IBM AT & compats.	3,895
PSExpress F650E1	—	ESDI	5-1/4 inch	I	701.8Mb	16ms	—	15Mbit/sec.	150,000	—	—		IBM PS/2 & compats.	3,995
Prevail F650S0	—	SCSI	5-1/4 inch	I	680Mb	16.5ms	3.5ms	20Mbit/sec.	150,000	—	33	multiuser/network applications	IBM AT & compats.	5,995

COMPARISON CHART: HARD DISK DRIVES

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Prevail E650S0	—	SCSI	—	E	680Mb	16.5ms	3.5ms	20Mbit/ sec.	150,000	—	33	multiuser/ network applications	IBM AT & compats.	6,395
CORE International **HC150**	half-height	ESDI	—	I	150Mb	17ms	4.8ms	—	100,000	—	—	3-yr. warranty	IBM PC & compats.	$ 1,895
HC310	half-height	ESDI	—	I	325Mb	18ms	4ms	—	100,000	—	—	3-yr. warranty	IBM PC & compats.	2,895
HC315	full-height	ESDI	—	I	340Mb	17ms	3.5ms	—	150,000	—	—	5-yr. warranty	IBM PC & compats.	2,895
Lan 310	—	—	—	E	310Mb	16ms	—	—		N/A	20.8	one full-height slot available for upgrade	IBM AT & compats.	3,985
HC655	full-height	ESDI	—	I	680Mb	17ms	3.5ms	—	151,000	—	—	5-yr. warranty	IBM PC & compats.	4,095
HC650	full-height	ESDI	—	I	658Mb	17ms	4.5ms	—	100,000	—	—	3-yr. warranty	IBM PC & compats.	4,995
Lan 650	—	—	—	E	650K	16ms	—	—		N/A	20.8	one full-height slot available	IBM AT & compats.	6,085
HC1000	full-height	ESDI	—	I	1056Mb	14ms	3ms	—	150,000	—	—	5-yr. warranty	IBM PC & compats.	6,495
Lan 310/2	—	—	—	E	620K	16ms	—	—		N/A	20.8	mirrored for NOVELL SFT, controller INCL.	IBM AT & compats.	6,880
Lan 310 DUPLEX	—	—	—	E	620K	16ms	—	—		N/A	20.8	duplexed for NOVELL SFT, controller included	any AT bus machine	7,375
Disctec **RoadRunner XD-120**	—	—	—	E	120Mb	—	—	—	—	—	—	weighs 1.5 pounds	IBM PC, XT, AT, & compats.	$1,900
Fujitsu **M2616SA**	half-height	SCSI	3-1/2 inch	I	105Mb	20ms	7ms	7.4Mbit/ sec.	50,000	—	7.2		IBM PC & compats.	$710

Make/Model	Drive Height	Drive Type	Form Factor	Mounting	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consumption (Watts)	Other Features	Works With	Price
M2616T	—	AT	3-1/2 inch	I	105Mb	20ms	7ms	7.4Mbit/sec.	50,000	—	7.2		IBM AT & compats.	710
M2614SA	half-height	SCSI	3-1/2 inch	I	182Mb	20ms	8ms	7.4Mbit/sec.	50,000	—	7.2		IBM PC & compats.	955
M2614T	—	AT	3-1/2 inch	I	180Mb	20ms	7ms	7.4Mbit/sec.	50,000	—	7.2		IBM AT & compats.	995
Hewlett-Packard C2235S	half-height	SCSI	3-1/2 inch	I	422Mb	13ms	3ms	3–5 Mbit/sec.	150,000	—	12.3	multiple recording zones	IBM PC & compats.	OEM only
C2234S	half-height	SCSI	3-1/2 inch	I	328Mb	13ms	3ms	3–5 Mbit/sec.	150,000	—	12.3	multiple recording zones	IBM PC & compats.	OEM only
C2233S	half-height	SCSI	3-1/2 inch	I	234Mb	13ms	3ms	3–5 Mbit/sec.	150,000	—	12.3	multiple recording zones	IBM PC & compats.	OEM only
HP 97556T/P	full-height	SCSI	5-1/4 inch	I	673Mb	13.5ms	3ms	1.5–5 Mbit/sec.	150,000	—	35	7.5ms latency	IBM PC & compats.	OEM only
HP 97556E	full-height	ESDI	5-1/4 inch	I	681Mb	13.5ms	3ms	23 Mbit/sec.	150,000	—	33	7.5ms latency	IBM PC & compats.	OEM only
HP 97544T/P	full-height	SCSI	5-1/4 inch	I	331Mb	16.5ms	3.5ms	1.5–5 Mbit/sec.	150,000	—	—	.5ms controller overhead, 7.5ms latency	IBM PC & compats.	OEM only
HP 97548T/P	full-height	SCSI	5-1/4 inch	I	683Mb	16.5ms	3.5ms	1.5–5 Mbit/sec.	150,000	—	—	.5ms controller overhead, 7.5ms latency	IBM PC & compats.	OEM only
HP 97544E Winchester Drive	full-height	ESDI	5-1/4 inch	I	340Mb	17ms	3.5ms	20Mbit/sec.	150,000	—	33	7.5ms latency	IBM PC & compats.	OEM only
HP 97548E Winchester Drive	full-height	ESDI	5-1/4 inch	I	680Mb	17ms	3.5ms	20Mbit/sec.	150,000	—	33	7.5ms latency	IBM PC & compats.	OEM only
HP 97544S/D Winchester Drive	full-height	SCSI	5-1/4 inch	I	331Mb	16.5ms	3.5ms	1.5–4 Mbit/sec.	150,000	—	34	.5ms controller overhead	IBM PC & compats.	OEM only

COMPARISON CHART: HARD DISK DRIVES

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
HP 97548S/D Winchester Drive	full-height	SCSI	5-1/4 inch	I	663Mb	16.5ms	3.5ms	1.5–4 Mbit/sec.	150,000	—	34	.5ms controller overhead	IBM PC & compats.	OEM only
HP 97532E	full-height	ESDI	5-1/4 inch	I	104Mb	17ms	3.5ms	10Mbit/sec.	40,000	—	30		IBM PC & compats.	OEM only
HP 97533E	full-height	ESDI	5-1/4 inch	I	156Mb	17ms	3.5ms	10Mbit/sec.	40,000	—	30		IBM PC & compats.	OEM only
HP 97536E	full-height	ESDI	5-1/4 inch	I	312Mb	17ms	3.5ms	10Mbit/sec.	40,000	—	30		IBM PC & compats.	OEM only
Iomega Bernoulli 90 Partner	half-height	SCSI II	5-1/4 inch	I	90Mb	19ms	—	20Mbit/sec.	60,000	backup, caching	30	no head cleaning required	IBM PC, XT, AT, & compats., Macintosh	$999
Bernoulli 90 Insider	half-height	SCSI II	5-1/4 inch	I	90Mb	19ms	—	20Mbit/sec.	60,000	backup, caching	18	no head cleaning required	IBM PC, XT, AT, & compats., Macintosh	1,099
Bernoulli 90 Transportable	—	SCSI II	—	E	90Mb	19ms	—	20Mbit/sec.	60,000	backup, caching	—	small footprint, 8.5 lbs., retractable handle	IBM PC, XT, AT, & compats., Macintosh	1,149
Bernoulli 90 Dual	—	SCSI II	—	E	180Mb (2 90Mb drives)	19ms	—	20Mbit/sec.	60,000	backup, caching	—	side-by-side removable 90Mb drives	IBM PC, XT, AT, & compats., Macintosh	2,249
Microscience International 7100-20	half-height	RLL	3-1/2 inch	I	120.4Mb	18ms	4ms	10Mbit/sec.	60,000	—	11	AT/IDE interface, on-board controller	IBM PC, AT, & compats.	$495
5100-20	half-height	RLL	3-1/2 inch	I	123.8Mb	18ms	4ms	10Mbit/sec.	60,000	—	11	magnetic actuator lock	IBM PC & compats.	575
7200	half-height	AT/IDE	3-1/2 inch	I	201Mb	18ms	4ms	12.5 Mbit/sec.	60,000	N	11	32K buffer	IBM PC, XT, AT, & compats.	695
FH-2777	full-height	ESDI	5-1/4 inch	I	687.6Mb	14ms	3ms	54Mbit/sec.	100,000	—	—	high drive and data integrity	—	1,549

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
FH-21200	full-height	ESDI	5-1/4 inch	I	1062.2Mb	14ms	3ms	72Mbit/sec.	100,000	—	—	high drive and data integrity	—	2,950
Plus Development **Plus Impulse 80Mb DriveKit**	third-height	SCSI	3-1/2 inch	I	80Mb	17ms	6ms	2–4 Mbit/sec.	60,000	—	6.5	up to 64Kb RAM, on-board DisCache	IBM micro channel systems	$599/ 799 (w/ SCSI adapter)
Plus Impulse 105Mb DriveKit	third-height	SCSI	3-1/2 inch	I	105Mb	17ms	6ms	2–4 Mbit/sec.	60,000	—	6.5	up to 64Kb RAM, on-board DisCache	IBM micro channel systems	799/ 999 (w/ SCSI adapter)
Plus Impulse 210Mb DriveKit	third-height	SCSI	3-1/2 inch	I	210Mb	15ms	4ms	2.3–4 Mbit/sec.	50,000	—	6.5	up to 64Kb RAM, on-board DisCache	IBM micro channel systems	1,549/ 1,749 (w/ SCSI adapter)
Plus Impulse 425Mb DriveKit	third-height	SCSI	3-1/2 inch	I	425Mb	13ms	4ms	4–5 Mbit/sec.	50,000	—	6.5	up to 64Kb RAM, on-board DisCache	IBM micro channel systems	2,799/ 2,999 (w/ SCSI adapter)
Procom Technology **Si80**	—	SCSI	3-1/2 inch	I	83Mb	24ms	—	1Mbit/sec.	150,000	Procom driver, utility	20		IBM PC, XT, AT, & compats.	$685
MD80	—	SCSI	—	E	83Mb	24ms	—	1Mbit/sec.	150,000	Procom driver, utility	7		IBM PC, XT, AT, & compats.	795
Si100	—	SCSI	3-1/2 inch	I	104Mb	18ms	—	1Mbit/sec.	70,000	Procom driver, utility	20		IBM PC, XT, AT, & compats.	850
MD100	—	SCSI	—	E	104Mb	18ms	—	1.25 Mbit/sec.	150,000	Procom driver, utility	7		IBM PC, XT, AT, & compats.	945
Si200	—	SCSI	3-1/2 inch	I	209Mb	18ms	—	2Mbit/sec.	70,000	Procom driver, utility	20		IBM PC, XT, AT, & compats.	1,495

COMPARISON CHART: HARD DISK DRIVES

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
MD200	—	SCSI	—	E	209Mb	18ms	—	1.5Mbit/ sec.	150,000	Procom driver, utility	7		IBM PC, XT, AT, & compats.	1,555
Si320H	—	SCSI	5-1/4 inch	I	331Mb	14ms	—	2.7Mbit/ sec.	100,000	driver, utility	24		IBM PC, XT, AT, & compats.	2,635
MD320	—	SCSI	—	E	332Mb	14ms	—	2.75 Mbit/ sec.	150,000	Procom driver, utility	7		IBM PC, XT, AT, & compats.	2,689
Si420H	—	SCSI	5-1/4 inch	I	435Mb	16ms	—	2.7 Mbit/ sec.	100,000	driver, utility	24		IBM PC, XT, AT, & compats.	2,865
Si320-10	—	SCSI	5-1/4 inch	I	337Mb	10.7ms	—	2Mbit/ sec.	100,000	driver, utility	24		IBM PC, XT, AT, & compats.	3,035
MD420	—	SCSI	—	E	433Mb	16ms	—	2.75 Mbit/ sec.	150,000	Procom driver, utility	7		IBM PC, XT, AT, & compats.	3,079
Si650	—	SCSI	5-1/4 inch	I	662Mb	15.5ms	—	1.8Mbit/ sec.	100,000	driver, utility	24		IBM PC, XT, AT, & compats.	3,195
MTD320-10	—	SCSI	—	E	337Mb	10.7ms	—	2Mbit/ sec.	100,000	Procom driver, utility	35		IBM PC, XT, AT, & compats.	3,329
MTD650	—	SCSI	—	E	662Mb	15.5ms	—	1.8Mbit/ sec.	100,000	Procom driver, utility	35		IBM PC, XT, AT, & compats.	3,599
Rodime Systems **Cobra 80at**	—	AT	3-1/2 inch	I	80Mb	20ms	—	6Mbit/ sec.	40,000	—	—	2-yr. warranty	IBM AT & compats.	—
Cobra 110at	—	AT	3-1/2 inch	I	110Mb	20ms	—	6Mbit/ sec.	40,000	—	—	2-yr. warranty	IBM AT & compats.	—
Cobra 210at	—	AT	3-1/2 inch	I	210Mb	20ms	—	6Mbit/ sec.	40,000	—	—	2-yr. warranty	IBM AT & compats.	—
Cobra 100i	—	SCSI	—	I	100Mb	18ms	—	10Mbit/ sec.	30,000	—	—	48K look ahead cache	Apple computers	$999

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Cobra 100e	—	SCSI	3-1/2 inch	E	100Mb	18ms	—	10Mbit/ sec.	30,000	—	30	automatic head park and lock	Apple computers	1,119
Cobra 210i	—	SCSI	—	I	210Mb	18ms	—	10Mbit/ sec.	30,000	—	—	48K look ahead cache	Apple computers	1,599
Cobra 210e	—	SCSI	3-1/2 inch	E	210Mb	18ms	—	10Mbit/ sec.	30,000	—	30	automatic head park and lock	Apple computers	1,799
Seagate ST3096A	—	RLL	3-1/2 inch	I	89.2Mb	15ms	3ms	12Mbit/ sec.	150,000	—	5.1	computer simulated SeaCache algorithm	IBM AT & compats.	OEM only
ST3120A	—	RLL	3-1/2 inch	I	106.9Mb	16ms	3ms	12Mbit/ sec.	150,000	—	5.1	computer simulated SeaCache algorithm	IBM AT & compats.	OEM only
ST3144A	—	RLL	3-1/2 inch	I	130Mb	16ms	3ms	14.5 Mbit/ sec.	150,000	—	5.1	computer simulated SeaCache algorithm	IBM AT & compats.	OEM only
ST3144N	—	SCSI	3-1/2 inch	I	126Mb	16ms	3ms	14.5 Mbit/ sec.	150,000	—	5.1	computer simulated SeaCache algorithm	IBM AT & compats.	OEM only
ST1096N	half-height	SCSI	3-1/2 inch	I	83.9Mb	20ms	8ms	7.5Mbit/ sec.	150,000	—	8		—	OEM only
ST1102A	half-height	—	3-1/2 inch	I	89.1Mb	19ms	8ms	12Mbit/ sec.	150,000	—	8	SeaCache 8K buffer	—	OEM only
ST1144A	half-height	—	3-1/2 inch	I	130.7Mb	19ms	8ms	12Mbit/ sec.	150,000	—	8	SeaCache 8K buffer	—	OEM only
Swift ST1100	half-height	MFM	3-1/2 inch	I	83.9Mb	15ms	4ms	5Mbit/ sec.	150,000	—	9	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1111E	half-height	ESDI	3-1/2 inch	I	98.8Mb	15ms	4ms	10Mbit/ sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Swift ST1133N	half-height	SCSI	3-1/2 inch	I	113.4Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1150R	half-height	RLL	3-1/2 inch	I	128.4Mb	15ms	4ms	7.5Mbit/sec.	150,000	—	9	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1186A	half-height	RLL	3-1/2 inch	I	163.8Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1186N	half-height	SCSI	3-1/2 inch	I	158.8Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1201N	half-height	SCSI	3-1/2 inch	I	171.9Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1201A	half-height	RLL	3-1/2 inch	I	177.5Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1201E	half-height	ESDI	3-1/2 inch	I	177.8Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1239N	half-height	SCSI	3-1/2 inch	I	204.2Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
Swift ST1239A	half-height	RLL	3-1/2 inch	I	210.7Mb	15ms	4ms	10Mbit/sec.	150,000	—	11	embedded AT interface, 15ms average seek time	IBM AT & compats.	OEM only
ST1400N	—	SCSI-2	3-1/2 inch	I	331Mb	14ms	2.5ms	17–25 Mbit/sec.	150,000	—	9	embedded AT interface	IBM AT & compats.	OEM only

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
ST1401N	—	SCSI-2	3-1/2 inch	I	338Mb	12ms	2.5ms	20–25 Mbit/ sec.	150,000	—	9	embedded AT interface	IBM AT & compats.	OEM only
ST1480N	—	SCSI-2	3-1/2 inch	I	426Mb	14ms	2.5ms	17–25 Mbit/ sec.	150,000	—	9	embedded AT interface	IBM AT & compats.	OEM only
ST1480A	—	ZBR	3-1/2 inch	I	426Mb	14ms	2.5ms	17–25 Mbit/ sec.	150,000	—	9	embedded AT interface	IBM AT & compats.	OEM only
ST1481N	—	SCSI-2	3-1/2 inch	I	426Mb	14ms	2.5ms	17–25 Mbit/ sec.	150,000	—	9	embedded AT interface	IBM AT & compats.	OEM only
ST296N	half-height	SCSI	5-1/4 inch	I	84.9Mb	70ms	28ms	10Mbit/ sec.	70,000	—	13	embedded AT interface	IBM AT & compats.	OEM only
Wren ST2106E	half-height	ESDI	5-1/4 inch	I	94Mb	18ms	4ms	10Mbit/ sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2106N	half-height	SCSI	5-1/4 inch	I	94Mb	18ms	4ms	10Mbit/ sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2125N	half-height	SCSI	5-1/4 inch	I	107Mb	18ms	4ms	9–15 Mbit/ sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2209N	half-height	SCSI	5-1/4 inch	I	183Mb	18ms	4ms	9–15 Mbit/ sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2182E	half-height	ESDI	5-1/4 inch	I	160Mb	16ms	4ms	9–15 Mbit/ sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2274A	half-height	RLL	5-1/4 inch	I	241Mb	16ms	3ms	15Mbit/ sec.	100,000	—	16	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2383A	half-height	RLL	5-1/4 inch	I	338Mb	16ms	3ms	15Mbit/ sec.	100,000	—	16	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2383E	half-height	ESDI	5-1/4 inch	I	338Mb	16ms	3ms	15Mbit/ sec.	100,000	—	15	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST2383N	half-height	SCSI	5-1/4 inch	I	337Mb	14ms	3ms	15Mbit/ sec.	100,000	—	15	Novell Netware ready	IBM AT, 386, 486	OEM only

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Wren ST2502N	half-height	SCSI	5-1/4 inch	I	442Mb	16ms	3ms	15Mbit/sec.	100,000	—	15	Novell Netware ready	IBM AT, 386, 486	OEM only
ST4096	full-height	MFM	5-1/4 inch	I	80.2Mb	28ms	6ms	5Mbit/sec.	40,000	—	23	28ms average seek time	IBM AT, 386, 486	OEM only
ST4144R	full-height	RLL	5-1/4 inch	I	122.7Mb	28ms	6ms	7.5Mbit/sec.	40,000	—	23	28ms average seek time	IBM AT, 386, 486	OEM only
Wren ST4097	full-height	MFM	5-1/4 inch	I	80Mb	28ms	5ms	5Mbit/sec.	40,000	—	28	vertical or horizontal mounting	IBM AT, 386, 486	OEM only
Wren ST4135R	full-height	RLL	5-1/4 inch	I	115Mb	28ms	5ms	7.5Mbit/sec.	40,000	—	28	vertical or horizontal mounting	IBM AT & compats.	OEM only
Wren ST4182N	full-height	SCSI	5-1/4 inch	I	155Mb	16.5ms	10ms	5Mbit/sec.	100,000	—	28	28ms average seek time	IBM AT & compats.	OEM only
Wren ST4182E	full-height	ESDI	5-1/4 inch	I	160Mb	16.5ms	10ms	5Mbit/sec.	100,000	—	28	28ms average seek time	IBM AT, 386, 486	OEM only
Wren ST4350N	full-height	SCSI	5-1/4 inch	I	307Mb	16.5ms	4ms	10–15 Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4376N	full-height	SCSI	5-1/4 inch	I	330Mb	17.5ms	4ms	9–15 Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4383E	full-height	ESDI	5-1/4 inch	I	338Mb	18ms	4ms	10Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4384E	full-height	ESDI	5-1/4 inch	I	338Mb	14.5ms	3ms	10Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4442E	full-height	ESDI	5-1/4 inch	I	380Mb	16ms	3ms	10Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4702N	full-height	SCSI	5-1/4 inch	I	613Mb	16.5ms	3ms	12–16 Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4385N	full-height	SCSI	5-1/4 inch	I	357Mb	10.7ms	3ms	15–16 Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4767N	full-height	SCSI-2	5-1/4 inch	I	676Mb	11.9ms	2.5ms	24Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
Wren ST4767E	full-height	ESDI	5-1/4 inch	I	676Mb	11.9ms	2.5ms	24Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4769E	full-height	ESDI	5-1/4 inch	I	691Mb	12.9ms	2.5ms	22Mbit/sec.	100,000	—	27	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4766N	full-height	SCSI	5-1/4 inch	I	676Mb	15.5ms	3ms	15Mbit/sec.	100,000	—	21	Novell Netware ready	IBM AT, 386, 486	OEM only
Wren ST4766E	full-height	ESDI	5-1/4 inch	I	676Mb	15.5ms	3ms	15Mbit/sec.	100,000	—	20	Novell Netware ready	IBM AT, 386, 486	OEM only
Systems Peripherals 90S	—	SCSI	3 1/2 inch	E	90	25ms	—	—	30,000	—	—	attaches directly to the expansion bus	Toshiba laptops	$995
90T	—	—	5 1/4 inch	E	90Mb	25ms	—	—	30,000	—	—	connects to printer port	IBM PC & compats, laptops	995
135S	—	SCSI	3 1/2 inch	E	135Mb	25ms	—	—	30,000	—	—	attaches directly to the expansion bus	Toshiba laptops	1,195
135T	—	—	5 1/4 inch	E	135Mb	25ms	—	—	30,000	—	—	connects to printer port	IBM PC & compats, laptops	1,195
182S	—	SCSI	3 1/2 inch	E	182Mb	25ms	—	—	30,000	—	—	attaches directly to the expansion bus	Toshiba laptops	1,395
182T	—	—	5 1/4 inch	E	182Mb	25ms	—	—	30,000	—	—	connects to printer port	IBM PC & compats, laptops	1,395
207S	—	SCSI	3 1/2 inch	E	207Mb	25ms	—	—	50,000	—	—	attaches directly to the expansion bus	Toshiba laptops	1,795
207T	—	—	5 1/4 inch	E	207Mb	25ms	—	—	30,000	—	—	connects to printer port	IBM PC & compats, laptops	1,795
Teac SD-380H	third-height	—	3-1/2 inch	I	86Mb	19ms	8ms	12.5 Mbit/sec.		—	4.7	internal data buffer, auto-shipping lock	—	$695

Make/Model	Drive Height	Drive Type	Form Factor	Mount-ing	Fixed Drive Capacity	Average Access Time	Average Track To Track	Data Transfer Rate	MTBF (hrs.)	Utility Software	Power Consump-tion (Watts)	Other Features	Works With	Price
SD-3105	third-height	—	3-1/2 inch	I	105Mb	19ms	8ms	12.5 Mbit/ sec.		—	4.7	64K data buffer, auto-shipping lock	—	795
Toshiba MK-1034FC	third-height	—	3-1/2 inch	I	107Mb	16ms	5ms	6Mbit/ sec.		—	3.5	64K look-ahead cache	IBM PC, AT, & compats.	$590
MK-438FB	—	SCSI-2	3-1/2 inch	I	867Mb	12.5ms	2ms	25Mbit/ sec.	200,000	—	10	8 platters to achieve an 1Gb unformatted capacity	—	2,295

HARD DISK DRIVE MANUFACTURERS

Atasi Technology, Inc.
2323-B Owen St., Santa Clara, CA 95054, (408) 986-1301

CMS Enhancements Inc.
2722 Michelson Dr., Irvine, CA 92715, (714) 222-6000

CORE International
7171 N. Federal Hwy., Boca Raton, FL 33487, (407) 997-6044

Disctec
147 W. Lyman Ave., Ste. 200, Winter Park, FL 32789, (407) 645-0001

Fujitsu America Inc.
3055 Orchard Dr., San Jose, CA 95134, (408) 432-1300, (800) 626-4686

Hewlett-Packard Co. Inquiries
19310 Pruneridge Ave., Cupertino, CA 95014, (800) 752-0900

Iomega Corp.
1821 W. 4000 S., Roy, UT 84067, (800) 456-5522

Microscience International Corp.
90 Headquarters Dr., San Jose, CA 95134, (408) 433-9898

Plus Development Corp.
500 McCarthy Blvd., Milpitas, CA 95035, (408) 434-6900

Procom Technology
200 McCormick Ave., Costa Mesa, CA 92626, (714) 549-9449

Rodime Systems
7700 W. Camino Real, Boca Raton, FL 33433, (407) 391-7333

Seagate Technology
920 Disc Dr., Scotts Valley, CA 95066-6550, (408) 438-6550

Systems Peripherals Consultants, Inc.
7950 Silverton Ave., Ste. 107, San Diego, CA 92126, (619) 693-8611, (800) 345-0824

Teac America
7733 Telegraph Rd., Montebello, CA 90640, (213) 726-0303

Toshiba America Informations Systems, Inc.
9740 Irvine Blvd., Irvine, CA 92718, (714) 583-3000, (800) 334-3445

PC UPGRADE

DISCOUNT PRICE GUIDE

A DIRECTORY OF LOWEST PRICES NATIONWIDE

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The Discount Price Guide staff regularly scans the country for the lowest prices available within each product catagory. They continually monitor newspaper and magazine advertising and maintain an ongoing phone dialog with outlets across the country. At the last moment before press time, the computer selects the lowest prices for each catagory. Due to the lead time necessary for the issue to reach the newsstands (several weeks), and the volatile nature of the discount marketplace, prices can fluctuate marginally up or down.

STREET PRICE BUYING TIPS

How to emerge unscathed from the hunt for hardware and software bargains.

Before you buy by mail or phone, you should be armed with information. The following advice should not lead you to believe that you're likely to run into severe problems if you order computer products, hardware, software, and peripherals by phone or mail order. What it is designed to do is protect your interests.

Many companies advertise that they will beat any offer. Low prices, however, are not always what they seem.

Check shipping charges Many companies pass the cost of shipping a package on to the buyer. Shipping rates are based on weight, shipping distance, and insurance to cover the value of the package. The United Parcel Service (UPS), for example, includes insurance for only the first $100 value of the package within the cost of their regular rates. Each additional $100 costs an additional 25 cents. If the company you ordered from had to ship a 60-pound dual-page color monitor with a declared value of $2,500 from New York City to San Francisco, the UPS charge would be approximately $30.

As you look at our Street Price Guide, remember that it's beside the point to use the Guide to find the lowest price available, only to pay more by using an out-of-state dealer rather than a local supplier.

Sales tax In most states, you are obligated to pay the sales tax in the state in which you reside for an out-of-state purchase. Many states include this in their income tax return form, indicating that you should declare and pay the Use Tax due from an out-of-state purchase.

Know what you are agreeing to Many states hold that you're forming a contract when you place your order. Write down exactly what you want to order before you talk to the dealer and make sure the dealer agrees to provide it. See our buying tips for specific products for more details about what to ask for.

If you've decided to order by mail, write the agreed terms in a letter you send when ordering your system. Time of delivery can be especially important, since some dealers will take your money but not ship your system for weeks.

Tell the dealer you want to receive your system within two weeks, and that you have no interest in buying anything that won't arrive within that time. Your dealer will be in violation of the contract if you don't get exactly what you want under the conditions you want. Point this out to him.

Many dealers provide what they claim is a money-back guarantee if you are not satisfied with their product. However, when you look at the fine print you often discover that your refund is subject to a "restocking" fee that can run as high as 15 percent. Profit margins on some units are as thin as 15 percent, but it's hardly the buyer's obligation to guarantee that a dealer makes a profit—especially when the buyer is dissatisfied with the system shipped.

Tell the dealer you have no intention of paying him to restock equipment that is no good. We're assuming that the system you receive really doesn't function; it would be unethical of you to decide you didn't want a working system and then expect the dealer to take it back without a fee. Read the fine print at the bottom of the advertisements for such disclaimers as, "We do not allow nondefective returns."

Write the dealer a letter as soon as you've ordered the unit. List the specific terms of the contract. This doesn't have to be in legalese. Your letter can simply state that you've ordered a system with certain additions at a specified price; that it must arrive within two weeks; that there is a money-back guarantee within so many days; and that you will not have to pay a restocking fee if the system doesn't work or arrives late. Keep a copy of this letter.

Credit card buying Many experienced buyers pay for the unit with a credit card and tell the dealer to charge their card only when the system is shipped. It can be very difficult to get your money back from the dealer if you paid by check or money order for a bad unit or one that never arrives.

If you ordered the unit on a credit card, you can simply refuse to pay the charges. Some credit card companies will charge you a fee of $50 for a canceled sale (just as they do with a stolen credit card); however, it's better to be out $50 than $1,000.

If the dealer demands payment anyway, tell the credit card company that the dealer contracted with you to deliver your system under certain conditions and then failed to meet these conditions. Tell them that the dealer used your card number without your permission and that you are under no obligation to pay.

You might send them a copy of the letter outlining the agreement you sent to the dealer. If you really believe the dealer is engaged in shady business practices, you might consider complaining to the U.S. Postmaster (if you ordered by mail) and the Federal Trade Commission (FTC).

Check what you've bought When your order arrives, no matter what it is, check it out immediately. When electronic parts fail, they normally do so immediately upon application of power. Those that pass this test still generally fail in the first minutes or hours of use. Your responsibility is to make sure the product works properly while it is still under guarantee.

Despite local and state laws designed to protect the consumer, it is still a case of "Let the Buyer Beware." *Computer Buyers Guide and Handbook* offers the Street Price Guide and the dealer listings only as a guide to what is available and in no way endorses or recommends any of the suppliers listed. ■

HARD DISK DRIVES

MAKE/ MODEL	CAPACITY (Mb)	SPEED (ms)	CONTROLLER	STREET PRICE	DEALER
ESDI					
Maxtor					
8760E	675	16	N	$1,329	Storage Devices Inc.
8760E	675	16	N	1,499	Advanced Computer
8760E	675	16	N	1,499	Computer Products Corp.
MX8380E	360	14	N	1,139	Storage Devices Inc.
MX8380E	360	14	N	1,179	Computer Products Corp.
MX8380E	360	14	N	1,199	Hard Drives Int'l
Micropolis					
MC1355	159	23	N	469	ET Valueline
MC1355	159	23	Y	549	Advanced Computer
MC1518	1345	14	N	2,359	Storage Devices Inc.
MC1518	1345	14	Y	2,599	DC Drives
MC1518	1345	14	Y	2,699	Advanced Computer
MC1558	338	18	N	1,199	ET Valueline
MC1568	660	16	N	1,395	Warehouse 54
MC1568	660	16	Y	1,429	DC Drives
MC1568	660	16	N	1,499	Hard Drives Int'l
MC1664	340	15	N	975	Warehouse 54
MC1664	340	15	Y	1,099	DC Drives
MC1664	340	15	N	1,099	Hard Drives Int'l
Seagate					
ST2182E	160	16	N	875	Storage Devices Inc.
ST2182E	160	16	N	949	Computer Products Corp.
ST2182E	160	16	N	975	Advanced Computer
ST2383E	337	15	N	1,159	DC Drives
ST2383E	337	15	N	1,190	Lyco Computer
ST2383E	337	15	N	1,250	One Stop Micro
ST4766E	660	15	N	1,375	Storage Devices Inc.
ST4766E	660	15	N	1,399	Computer Products Corp.
ST4766E	660	15	N	1,439	DC Drives
IDE					
Conner					
CP3000	42	25	N	169	DC Drives
CP3000	42	25	N	199	Hard Drives Int'l
CP3000	42	25	N	205	Shecom Computers
CP30104	120	19	N	339	Quick Electronics
CP30104	120	19	N	359	California Microchip
CP30104	120	19	N	369	MegaHaus
CP3204	210	16	N	$519	Computer Products Corp.
CP3204	210	16	N	539	Storage Devices Inc.
CP3204	210	16	N	559	DC Drives
Kalok					
KL3100	105	25	N	289	Storage Devices Inc.
Maxtor					
7040A	42	19	N	195	Storage Devices Inc.
7040A	42	19	N	199	Computer Products Corp.
7040A	42	19	N	205	DC Drives
7080A	80	17	N	279	Hard Drives Int'l
7080A	80	17	Y	289	Warehouse 54
7080A	80	17	N	299	Computer Products Corp.
Quantum					
LPS105A	105	17	N	299	Computer Products Corp.
LPS105A	105	17	N	349	Hard Drives Int'l
LPS105A	105	17	N	359	Advanced Computer
LPS52A	52	17	N	189	Computer Products Corp.
LPS52A	52	17	N	209	Hard Drives Int'l
LPS52A	52	17	N	209	Storage Devices Inc.
PRO210A	210	15	N	499	Computer Products Corp.
PRO210A	210	15	N	619	Storage Devices Inc.
PRO210A	210	15	N	649	Hard Drives Int'l
Seagate					
ST1144A	125	20	N	369	Main Street Computer
ST1144A	125	20	N	375	Global Electronics
ST1144A	125	20	N	390	One Stop Microo
ST1239A	211	15	N	599	Main Street Computer
ST1239A	211	15	N	670	One Stop Micro
ST1239A	211	15	N	675	Global Electronics
ST2383A	335	14	N	1,145	Advanced Computer
ST2383A	335	14	N	1,189	MegaHaus
ST2383A	335	14	N	1,292	Minuteman Computers
Teac					
SD380	86	22	Y	284	California Microchip
Toshiba					
MK1034	105	16	N	319	Hard Drives Int'l
MK1034	105	16	N	349	FastMicro
MK1034	105	16	N	349	Warehouse 54
MK234FCF	104	17	N	345	Shecom Computers
Western Digital					
WD200	210	15	N	579	Shecom Computers
WD280A	80	20	N	285	Shecom Computers
WD280A	80	20	N	299	FastMicro

*For dealer addresses and phone numbers see page 96   NA denotes not available   * For further explanation see Street Price Buying Tips*

STREET PRICE GUIDE: HARD DISK DRIVES

MAKE/ MODEL	CAPACITY (Mb)	SPEED (ms)	CONTROLLER	STREET PRICE	DEALER
MFM					
Mitsubishi					
MR535	42	28	N	$199	DC Drives
Seagate					
ST1100	88	15	N	569	DC Drives
ST228	45	28	N	170	One Stop Micro
ST251-1	40	28	N	225	Computer Spectrum
ST251-1	40	28	N	225	One Stop Micro
ST251-1	40	28	N	235	Minuteman Computers
ST4096	80	28	N	399	MicroLab
ST4096	80	28	N	449	Hard Drives Int'l
ST4096	80	28	Y	509	Computer Products Corp.
RLL					
Mitsubishi					
MR535	63	28	N	199	DC Drives
MR535	65	28	N	199	MegaHaus
Seagate					
ST157R	50	28	N	190	One Stop Micro
ST157R	50	28	N	220	Lyco Computer
ST157R	50	28	N	229	MicroLab
ST157R	50	28	Y	259	Computer Products Corp.
ST238R	30	65	N	185	DC Drives
ST238R	30	65	N	185	Lyco Computer
ST4144R	120	28	N	499	MicroLab
ST4144R	120	28	Y	539	Computer Products Corp.
SCSI					
Conner					
CP30080	84	18	N	319	Computer Products Corp.
CP30080	84	18	N	345	Storage Devices Inc.
CP30080	84	18	N	349	DC Drives
CP30100	120	18	N	345	Quick Electronics
CP30100	120	18	N	369	Storage Devices Inc.
Fujitsu					
M2263S	675	16	N	1,219	Quick Electronics
M2263S	675	16	N	1,299	MegaHaus
M2263S	675	16	N	1,339	DC Drives
M2266S	1079	12	N	1,939	DC Drives
M2266S	1079	12	N	1,969	Storage Devices Inc.
M2266S	1079	12	N	1,989	MegaHaus
M2622S	330	12	N	1,269	Storage Devices Inc.
M2622S	330	12	N	1,279	MegaHaus
M2622S	330	12	N	2,179	DC Drives
M2624S	520	12	N	1,339	Quick Electronics
M2624S	520	12	N	1,429	DC Drives
M2624S	520	12	N	1,439	MegaHaus
Imprimis					
ST41200N	1050	14	N	1,899	Warehouse 54
ST41200N	1050	14	N	2,099	Hard Drives Int'l.
Maxtor					
MX117S	1470	13	N	$2,599	DC Drives
MX117S	1470	13	Y	2,599	Hard Drives Int'l.
MX117S	1470	13	N	2,799	Computer Products Corp.
PO 12S	1025	13	N	2,049	DC Drives
PO 12S	1025	13	N	2,099	Advanced Computer
PO 12S	1025	13	N	2,199	Computer Products Corp.
Micropolis					
MC1528	1350	14	N	2,359	Quick Electronics
MC1528	1350	14	N	2,439	DC Drives
MC1528	1350	14	N	2,699	Hard Drives Int'l.
MC1548	1748	14	N	3,199	Storage Devices Inc.
MC1548	1748	14	N	3,239	DC Drives
MC1548	1748	14	N	3,259	MegaHaus
MC1588	660	16	N	1,349	DC Drives
MC1588	660	16	N	1,499	Hard Drives Int'l.
MC1588	660	16	N	1,645	Shecom Computers
MC1598	1035	14	N	1,975	Storage Devices Inc.
MC1598	1035	14	N	2,095	Warehouse 54
MC1598	1035	14	N	2,199	Hard Drives Int'l
Quantum					
LPS105S	105	12	N	319	Computer Products Corp.
LPS105S	105	12	N	339	Storage Devices Inc.
LPS105S	105	12	N	349	MegaHaus
LPS52S	52	12	N	199	Computer Products Corp.
LPS52S	52	12	N	219	Storage Devices Inc.
LPS52S	52	12	N	269	Advanced Computer
PRO210S	210	15	N	589	Computer Products Corp.
PRO210S	210	15	N	639	DC Drives
PRO210S	210	15	N	649	Storage Devices Inc.
Seagate					
ST177N	60	20	N	249	Computer Products Corp.
ST296N	85	28	N	259	Computer Products Corp.
ST296N	85	28	N	265	Storage Devices Inc.
ST296N	85	28	N	269	DC Drives
ST41200N	1050	15	N	1,999	Computer Products Corp.
ST41200N	1050	15	N	2,049	Lyco Computer
ST41200N	1050	15	Y	2,299	Hard Drives Int'l.
ST41650N	1420	15	N	2,459	Lyco Computer
ST41650N	1420	15	N	2,469	Computer Products Corp.
ST41650N	1420	15	N	2,479	DC Drives
ST4350N	300	18	N	1,099	Computer Products Corp.
ST4350N	300	18	N	1,129	Storage Devices Inc.
ST4376N	330	17	N	1,099	Computer Products Corp.
ST4376N	330	17	N	1,169	DC Drives
ST4376N	330	17	N	1,199	Hard Drives Int'l.

FLOPPY DISK DRIVES

MAKE/ MODEL	MOUNT- ING	STREET PRICE	DEALER
3.5 DOUBLE DENSITY			
Chinon	I	$46	Verticom Corp.
Chinon	I	49.95	Lyco Computer
Chinon	I	50	Quick Electronics
Chinon	I	51	ComputAbility
Chinon	I	51	MidWest MicroPeripherals
Mitsumi	I	46	Syntax Computer
Sony	I	59	ET Valueline
Teac	I	54	Shecom Computers
Teac	I	57	California MicroChip
Teac	I	59	Computer Spectrum
Teac	I	59	Hard Drives Int'l.
Teac	I	59	Warehouse 54
Teac	I	59.95	Main Street Computer
Teac	I	65	Minuteman Computers
3.5 HIGH DENSITY			
Chinon	I	55	Quick Electronics
Chinon	I	55	Verticom Corp.
Chinon	I	58	MidWest MicroPeripherals
Chinon	I	59	ComputAbility
Chinon	I	58.95	Lyco Computer
Chinon	I	59	Myoda Inc.
Chinon	I	64	Hard Drives Int'l.
Citizen	I	59	MidWest MicroPeripherals
Mitsumi	I	52	Syntax Computer
Mitsumi	I	55	US Turbo Sys. & Comp.
Mitsumi	I	56	Mile Hi Micro
Mitsumi	I	65	Sunnytech
Sony	I	59	ET Valueline
Sony	I	59	MidWest MicroPeripherals
Teac	I	57	Shecom Computers
Teac	I	58	California MicroChip
Teac	I	59	Warehouse 54
Teac	I	59.95	Main Street Computer
Teac	I	65	FastMicro
Teac	I	69	Lucky Computer
Toshiba	I	59	MicroLab
Toshiba	I	59	Warehouse 54
Toshiba	I	63	MidWest MicroPeripherals
Toshiba	I	64	Hard Drives Int'l.
Toshiba	I	67.95	Lyco Computer
Toshiba	I	69	Arlington Computer
Toshiba	i	$69	MidWest Computer Works
5.25 DOUBLE DENSITY			
Chinon	I	46	Verticom Corp.
Chinon	I	49	MidWest MicroPeripherals
Chinon	I	49	Quick Electronics
Chinon	I	54	ComputAbility
Chinon	I	54.95	Lyco Computer
Mitsumi	I	42	Syntax Computer
Teac	I	52	One Stop Micro
Teac	I	54	Shecom Computers
Teac	I	54	Warehouse 54
Teac	I	57	California MicroChip
Teac	I	59	Computer Spectrum
Teac	I	59	Hard Drives Int'l.
Teac	I	59	Minuteman Computers
Toshiba	I	58	MidWest MicroPeripherals
Toshiba	I	59	ET Valueline
Toshiba	I	59	FastMicro
Toshiba	I	59.95	Lyco Computer
5.25 HIGH DENSITY			
Chinon	I	55	Quick Electronics
Chinon	I	55	Verticom Corp.
Chinon	I	59	ComputAbility
Chinon	I	59	Myoda Inc.
Chinon	I	59.95	Lyco Computer
Chinon	I	64	Hard Drives Int'l.
Ergo	I	49	California MicroChip
Mitsumi	I	52	Syntax Computer
Mitsumi	I	54	US Turbo Sys. & Comp.
Mitsumi	I	56	Mile Hi Micro
Mitsumi	I	65	Sunnytech
Teac	I	57	Shecom Computers
Teac	I	59	California MicroChip
Teac	I	59	Warehouse 54
Teac	I	62.95	Main Street Computer
Teac	I	65	FastMicro
Teac	I	65	Lucky Computer
Toshiba	I	59	MicroLab
Toshiba	I	59	Warehouse 54
Toshiba	I	64	Hard Drives Int'l.
Toshiba	I	69	MidWest Computer Works
Toshiba	I	69.95	Lyco Computer

I = Internal   E = External   For dealer addresses and phone numbers see page 96

MONITORS: CGA, EGA, MULTISYNC, SVGA, VGA

MAKE/ MODEL	STREET PRICE	LIST PRICE	DEALER
CGA MONITORS			
Emerson			
14 CGA	$129.99	$339	Damark
Samsung			
ML4571	116.50	159	Computer Discount Whse.
ML4571	135	159	Syntax Computer
MULTISYNC MONITORS			
Cornerstone			
DualPage	1,875	2,645	Publisher's Toolbox
DualPage	1,878	2,645	Publishing Perfection
DualPage 16GS	2,368	3,295	Publishing Perfection
DualPage 16GS	2,379	3,295	Publisher's Toolbox
XL SinglePage	919	1,395	Publishing Perfection
XL SinglePage	925	1,395	Publisher's Toolbox
GoldStar			
1460+	299	799	Arlington Computer
1460+	299	799	MicroProfessionals
1460+	325	799	Action Computer Supplies
1620+	699	1,099	Arlington Computer
1620+	699	1,099	MicroProfessionals
1620+	779	1,099	Action Computer Supplies
Hitachi			
CM2087	1,799	3,299	MicroProfessionals
CM2087	2,165	3,299	Computer Input Products
CM2087	2,695	3,299	CAD & Graphics
CM2187	2,550	3,799	Computer Input Products
CM2187	2,699	3,799	MicroProfessionals
IBM			
8515	699	950	Paradise
IDEK			
MF 5217	1,027	2,599	CTS
MF 5217	1,195	2,599	Computer Input Products
MF 5217	1,295	2,599	Laser Press & Graphics
Mitsubishi			
HL 6605	989	1,945	MidWest Computer Works
HL 6605	1,049	1,945	Kenosha Computer
HL 6615	1,029	3,570	Arlington Computer
HL 6935	1,900	3,999	Paradise
HL 6945	1,785	4,599	MidWest Computer Works
HL 6945	1,789	4,599	Arlington Computer
HL 6945	1,789	4,599	Kenosha Computer
NEC			
MS 2A	375	999	One Stop Micro
MS 2A	428	999	Hi Tech USA
MS 2A	$429	$999	MidWest Computer Works
MS 3D	499	1,199	One Stop Micro
MS 3D	535	1,199	Kenosha Computer
MS 3D	549	1,199	Arlington Computer
MS 3FGX	599	1,299	FastMicro
MS 3FGX	609.78	1,299	Computer Discount Whse.
MS 3FGX	639	1,299	ET Valueline
MS 3FGX	665	1,299	Bulldog Computer
MS 3FGX	695	1,299	CAD & Graphics
MS 4Ds	940	1,499	One Stop Micro
MS 4Ds	979	1,499	Bulldog Computer
MS 4Ds	999	1,499	ET Valueline
MS 4FG	732.60	1,299	Computer Discount Whse.
MS 4FG	749	1,299	FastMicro
MS 4FG	775	1,299	CAD & Graphics
MS 4FG	799	1,299	Bulldog Computer
MS 5D	2,099	3,699	ET Valueline
MS 5D	2,195	3,699	CAD & Graphics
MS 5D	2,350	3,699	Bulldog Computer
MS 5FG	1,299.26	2,199	Computer Discount Whse.
MS 5FG	1,345	2,199	Telemart
MS 5FG	1,429	2,199	Laser Press & Graphics
MS 6FG	2,799	3,999	Telemart
MS 6FG	2,819.50	3,999	Computer Discount Whse.
MS 6FG	2,999	3,999	Laser Press & Graphics
Nanao			
9070U	898	1,779	Hi Tech USA
9070U	969	1,779	Hokkins Systemation
9070U	1,019	1,779	Bulldog Computer
9070U	1,019	1,779	MidWest Computer Works
9080i	1,078	1,999	Hi Tech USA
9080i	1,099	1,999	Hokkins Systemation
9080i	1,199	1,999	MidWest Computer Works
9080i	1,269	1,999	Bulldog Computer
9400i	2,465	3,999	CAD & Graphics
9400i	2,673	3,999	Compu$ave
9500	1,922	3,999	Compu$ave
9500	2,495	3,999	CAD & Graphics
9500	2,795	3,999	Computer Input Products
Packard Bell			
PB8510	329	899	Micro Sales
PB8510	339	899	Paradise
Panasonic			
C1381	329	699	Kenosha Computer

For dealer addresses and phone numbers see page 96

STREET PRICE GUIDE: MONITORS

MAKE/ MODEL	STREET PRICE	LIST PRICE	DEALER
C1381	$369	$699	Microwarehouse
C1381	369	699	Paradise
C1391	449	799	Bulldog Computer
C1391	459	799	Paradise
C1395	429	899	MicroProfessionals
C1395	469	899	Access Technologies
C1395	539	899	Kenosha Computer
C1395	549	899	Bulldog Computer
C1991	1,559	2,599	Arlington Computer
Princeton Graphics			
Ultra 1200	460	849	Global Electronics
Ultra 1200	480	849	Minuteman Computers
Ultra 1400	449	849	Telemart
Ultra 1400	499	849	Global Electronics
Ultra 1400	519	849	Microcomputer Concepts
Ultra 1400	520	849	Minuteman Computers
Ultra 1600	820	1,375	Global Electronics
Ultra 1600	839	1,375	Telemart
Ultra 1600	845	1,375	Minuteman Computers
Ultra 1600	859	1,375	Microcomputer Concepts
Ultra 2000	1,950	3,395	Global Electronics
Ultra 2000	1,980	3,395	Minuteman Computers
Sampo			
TriSync	1,250	1,895	Computer Input Products
TriSync	1,295	1,895	CAD & Graphics
Samsung			
4581	430	729	Paradise
CSA7571	805	1,499	One Stop Micro
Seiko			
CM 2050	1,765	2,999	Treasure Chest
CM 2050	1,919	2,999	MidWest Computer Works
CM 2050	1,949	2,999	Compu$ave
Sigma Designs			
L'View	1,586	1,999	Publishing Perfection
SilverView	1,765	2,199	Publishing Perfection
Sony			
GVM2000	1,425	2,300	One Stop Micro
GVM2000	1,450	2,300	Global Electronics

SVGA MONITORS

MAKE/ MODEL	STREET PRICE	LIST PRICE	DEALER
IBM			
8507	499	865	Exsel, Inc.
8507	629	865	Paradise
8514	449	1,620	Exsel, Inc.
8514	1,150	1,620	Paradise
Optiquest			
2000	449	995	Focus Computer
2000	469	995	MicroProfessionals
2000	575	995	Computer Input Products
2000	595	995	CAD & Graphics
Packard Bell			
PB8528	315	799	Computability
PB8528	329	799	MidWest Computer Works
PB8528	335.56	799	Computer Discount Whse.
PB8529	$275	$699	Paradise
PB8529	289	699	Micro Sales
PB8539	219	599	Computability
PB8539	229.57	599	Computer Discount Whse.
PB8539	259	599	Micro Sales
Sampo			
AlphaScan 14	469	789	CAD & Graphics
AlphaScan 20	1,650	2,995	Computer Input Products
AlphaScan 20	1,695	2,995	CAD & Graphics
OfficePro II	895	1,399	Computer Input Products
OfficePro II	995	1,399	CAD & Graphics
OfficePro IIA	1,395	2,799	CAD & Graphics
Seiko			
CM 1440	440	899	Treasure Chest
CM 1440	495	899	MidWest Computer Works
CM 1440	665.95	899	TriState Computer
CM 1450	575	999	Treasure Chest
CM 1450	619.95	999	TriState Computer
CM 1450	685	999	MidWest Computer Works
Sony			
1304	569	1,149	Access Technologies
1304	579	1,149	Hokkins Systemation
1304	589	1,149	Computability
1304	675	1,149	Microwarehouse

VGA MONITORS

MAKE/ MODEL	STREET PRICE	LIST PRICE	DEALER
IBM			
8503	179	275	Exsel, Inc.
8503	209.95	275	TriState Computer
8503	227	275	Paradise
8506	899	1,399	Paradise
8508	928	1,499	Paradise
8512	269	675	Exsel, Inc.
8512	449.95	675	TriState Computer
8512	459	675	Paradise
8513	299	750	Exsel, Inc.
8513	519.95	750	TriState Computer
8513	525	750	Paradise
Mitsubishi			
XC 1429	385	658	Microcomputer Concepts
XC 1429	389	658	Arlington Computer
XC 1429	403	658	Compu$ave
Optiquest			
1000	345	899	Focus Computer
1000	369	899	MicroProfessionals
1000	425	899	Computer Input Products
Packard Bell			
PB8541	290	559	Paradise
Zenith			
1492	459	999	Focus Computer
1492	589.95	999	TriState Computer
1492	599	999	FastMicro

SOFTWARE

MANUFACTURER/ PRODUCT	STREET PRICE	LIST PRICE	DEALER
UTILITY SOFTWARE			
Abacus			
BeckerTools	$69	$139	Software Add Ons
BeckerTools	76	139	MicroWarehouse
BeckerTools	79	139	Publishing Perfection
Above Software			
Above Disk	54	120	Software Add Ons
Above Disk	56	120	SoftComp USA
Ashton Tate			
Control Room	69	129	FastMicro
Control Room	75	129	Software Add Ons
Asymetrix			
Toolbook	277	395	Publishing Perfection
Toolbook	279	395	FastMicro
Toolbook	295	395	PC Zone
Atech/M			
Pub's PowerPak	39	79.95	Publishing Perfection
Pub's PowerPak	45	79.95	FastMicro
Pub's PowerPak	55	79.95	MicroWarehouse
Bloc Publishing			
PopDrop+	53	99.95	FastMicro
PopDrop+	53	99.95	Software Add Ons
Borland			
ObjectVision	87	99	Star Ware
ObjectVision	89	99	PC Zone
Sidekick+	127	199.95	Software Unlimited
Bourbaki			
1 Dir+	44	95	SoftComp USA
1 Dir+	45	95	Software Unlimited
1 Dir+	45	95	Telemart
Broderbund			
MemoryMate 3.0	38	69	PC Zone
Central Point			
AntiVirus	82.99	129	America's Most Wanter S/W
AntiVirus	84	129	PC Connection
BackUp 7.0	59	129	PC Zone
BackUp 7.0	75.95	129	ComputAbility
Copy II PC 5.0	25.95	39.95	ComputAbility
Copy II PC 6.0	23	39.95	Telemart
Copy II PC 6.0	24	39.95	PC Zone
PCTools Deluxe	112	179	ALpc, Inc.
PCTools Deluxe	114.99	179	America's Most Wanted S/W
PCTools Deluxe	115	179	PC Connection
Dariana Technologies			
SystemSleuth Pro	63	149	MicroWarehouse
SystemSleuth Pro	$82	$149	PC Zone
WinSleuth	79.95	149	ComputAbility
WinSleuth	82	149	PC Zone
WinSleuth	85	149	MicroWarehouse
Delta Technology			
Direct Access 5.0	59	89.95	Telemart
Direct Access 5.0	59.95	89.95	ComputAbility
Direct Access 5.0	62.99	89.95	America's Most Wanted S/W
Direct Net	147	395	Star Ware
Fifth Generation			
FastBack+ 2.1	109	189.95	Star Ware
FastBack+ 2.1	112	189.95	Compuclassics
FastBack+ 2.1	119	189.95	Dustin Discount
Mace 1990	85	149	Software Unlimited
Mace 1990	87	149	Software Add Ons
Mace 1990	99	149	Dustin Discount
Mace Vaccine	53	99	Software Unlimited
Mace Vaccine	59	99	Software Add Ons
Suitcase II	47	79	Publisher's Toolbox
Funk Software			
Allways 1.2	104	195	Software Unlimited
Allways 1.2	109	195	Software Add Ons
Allways 1.2	119	195	Dustin Discount
Sideways 3.2	65	89.95	Dustin Discount
Sideways 3.3	54	89.95	Telemart
Sideways 3.3	54.99	89.95	America's Most Wanted S/W
Gazelle			
OPtune	42	99.95	Telemart
OPtune	45	99.95	Software Add Ons
OPtune	49	99.95	Software Unlimited
Gibson Research			
SpinRite II	59.95	89	ComputAbility
SpinRite II	61.95	89	Computer Discount Whse.
SpinRite II	64	89	Compuclassics
hDC			
1st Apps	52	99.95	Publishing Perfection
FileApps	69	99	MicroWarehouse
Icon Designer	32	59	Telemart
Icon Designer	35	59	PC Connection
Windows Express	52	99.95	Publishing Perfection
Helix			
Headroom 2.0	59	129	FastMicro
Headroom 2.0	64	129	PC Zone

For dealer addresses and phone numbers see page 96

MANUFACTURER/ PRODUCT	STREET PRICE	LIST PRICE	DEALER
Headroom 2.0	$65	$129	Software Unlimited
NetRoom	49	79	MicroWarehouse
NetRoom	49.95	79	ComputAbility
NetRoom	52	79	PC Connection
NetRoom LAN 4	91	149	MicroWarehouse
NetRoom LAN 5.0	362.95	379	ComputAbility
IBM			
Current 1.1	129	395	Compuclassics
Current 1.1	209	395	Software Add Ons
Current 1.1	217.73	395	Computer Discount Whse.
Laser Tools			
PrinCache	91.95	129	ComputAbility
PrinCache	98	129	Publishing Perfection
PrinCache	99	129	Publisher's Toolbox
Trading Post	61	79	Publishing Perfection
LaserGo			
GoScript 3.0	85	149	Software Add Ons
GoScript 3.0	88	149	Telemart
GoScript+	172	299	Software Add Ons
GoScript+	175	299	Telemart
Lotus Development			
Magellan	89	139	PC Zone
Magellan	115	139	Dustin Discount
Metro	59	85	Software Unlimited
Metro	69	85	Dustin Discount
Magee Enterprises			
AutoMenu 4.5	35	69.95	Telemart
AutoMenu 4.5	39	69.95	Compuclassics
AutoMenu 4.5	45	69.95	Dustin Discount
Merrill & Bryan			
Turbo EMS	52	99.95	Software Add Ons
Turbo EMS	55	99.95	PC Zone
Turbo EMS	56	99.95	MicroWarehouse
Metro ImageBase			
LaserTwin	117	149	Publishing Perfection
Microcom			
Virex PC 1.1	73	129	SoftComp USA
Virex PC 1.1	75	129	PC Zone
Virex PC 1.1	75	129	Star Ware
Microlytics			
GOfer 2.0	42	79.95	Software Add Ons
GOfer 2.0	44	79.95	Software Unlimited
Microsoft			
Windows 3.0	87	129	Software Add Ons
Windows 3.0	89	129	FastMicro
Peter Norton			
AntiVirus	79	129	Star Ware
AntiVirus	83.95	129	ComputAbility
AntiVirus	85.99	129	America's Most Wanted S/W
Utilities	89	159	Software Add Ons
Utilities	110	159	Telemart
Utilities	115	159	Compuclassics
Polaris			
PackRat 3.0	249	495	ALpc, Inc.
PackRat 3.0	259	495	MicroWarehouse
Prime Solutions			
Disk Tech Gold	$99	$149.95	ComputerMill
Disk Tech Gold	109	149.95	Dustin Discount
Prisma			
YourWay	129	229	MicroWarehouse
QMS			
UltraScript PC	105	295	Software Add Ons
UltraScript PC+	255	445	Software Add Ons
UltraScript PC+	279	445	MicroWarehouse
Qualitas			
386 Max	67	130	Software Add Ons
386 Max	68	130	Software Unlimited
Quarterdeck			
DeskView 386	125	219.50	Software Add Ons
DeskView 386	139	219.50	Dustin Discount
DesqView II	73	129.95	Software Add Ons
DesqView II	85	129.95	Dustin Discount
QEMM 386	61	99.95	ALpc, Inc.
QEMM 386	62	99.95	Compuclassics
QEMM 386	69	99.95	Dustin Discount
Revolution Software			
VGA Dimmer	24	79	Star Ware
VGA Dimmer	25	79	Telemart
SoftLogic Solutions			
Disk Optimizer	30	69.95	Telemart
Disk Optimizer	36	69.95	Software Add Ons
Software Carousel	50	89.95	Software Add Ons
Software Carousel	59	89.95	Loma Computer
Software Directions			
PrinQ LAN	285	495	MicroWarehouse
PrinQ LAN	299	495	Software Add Ons
PrintQ 4.0	79	149	Telemart
PrintQ 4.0	89	149	Dustin Discount
PrintQ 5.0	80	149	Software Add Ons
Systems Compatibility			
Software Bridge	70	129	Telemart
Software Bridge	79	129	Loma Computer
Touchstone Software			
Check It 2.1	79.95	149	ComputAbility
Check It 2.1	84	149	PC Zone
Check It 2.1	85	149	MicroWarehouse
Travelling Software			
Battery Watch Pro	27	49.95	Software Add Ons
Battery Watch Pro	28.95	49.95	ComputAbility
Westlake Data			
PathMinder 4.11	47	79.95	Software Add Ons
PathMinder+	69	99.95	Software Add Ons
White Crane Systems			
Brooklyn Bridge	83	129	SoftComp USA
Brooklyn Bridge	91	129	Loma Computer
XTree			
XTree Gold	89	149	Telemart
XTree Gold	90.50	149	America's Most Wanted S/W
Zenographics			
SuperPrint	119	195	Publisher's Toolbox

DEALERS

ALpc, Inc.
8920 Wilshire Blvd., Ste. 430, Beverly Hills, CA 90211, Phone: (800) 955-2572, (213) 659-6053

Access Computer
2225 El Camino Real, Santa Clara, CA 95050, Phone: (800) 359-6800, (408) 247-4444

Action Computer Supplies
6100 Stewart Ave., Fremont, CA 94538, Phone: (800) 822-3132

Advanced Computer Produts
1310 E. Edinger, Santa Ana, CA 92705, Phone: (800) FONE-ACP, (800) 366-3227

America's Most Wanted Software
2401 West Bay Dr., Ste. 126, Largo, FL 34640 Phone: (813) 588-1341, (813) 588-1339

Arlington Computer Products
1970 Carboy, Mt. Prospect, IL 60056, Phone: (800) 548-5105, (708) 228-6333

Bulldog Computer Products
610 Industrial Park Dr., Evans, GA 30809, Phone: (800) 438-6039, (404) 860-7364

CAD & Graphics
1301 Evans, San Francisco, CA 94104, Phone: (800) 288-1611, (415) 647-9671

CTS
8560 Howard Dr., Houston, TX 77017, Phone: (800) 275-7788, (713) 644-3600

California Microchip
9240 Deering Ave., Chatsworth, CA 91311, Phone: (800) PRO-CHIP, (818) 884-3660

Compu$ave
4209 S. 37th St., Dept. S8, Phoenix, AZ 85040, Phone: (800) 544-8302, (602) 437-8298

Compuclassics
PO Box 10598, Canoga Park, CA 91309, Phone: (800) 733-3888

ComputAbility
PO Box 17882, Milwaukee, WI 53217, Phone: (800) 558-0003, (414) 357-8181

Computer Discount Warehouse
2840 Maria, Northbrook, IL 60062, Phone: (800) 233-4426, (708) 498-1426

Computer Input Products
1301 Evans Ave., San Francisco, CA 94124, Phone: (800) 825-1187, (415) 647-2684

Computer Products Corp.
1431 S.Cherryvale Road, Boulder, CO 80303, Phone: (800) 338-4273

Computer Spectrum
201 Pacific Coast Hwy., Wilmington, CA 90477, Phone: (800) 388-8550, (213) 518-2321

Computermill
43234 Christy St., Fremont, CA 94538, Phone: (800) 800-5592, (415) 623-8843

DC Drives
1110 NASA Rd., 1, Ste. 304, Nassau Bay, TX 77058, Phone: (800) 872-6007, (713) 333-9602

Damark
7101 Winnetka Ave., N., Minneapolis, MN 55428-1619, Phone: (800) 729-9000

Dustin Discount
20969 Ventura Blvd., Ste. 13, Woodland Hills, CA 91364, Phone: (800) 274-6611, (818) 710-9174

ET Valueline
7350 N. Linder Ave., Skokie, IL 60077, Phone: (800) 395-1000, (708) 677-7660

Exsel, Inc.
2200 Brithton-Henrietta Rd., Rochester, NY 14623, Phone: (800) 624-2001, (716) 272-8770

FastMicro
3655 E. LaSalle St., Phoenix, AZ 85040, Phone: (800) 441-3278, (602) 437-0300

Focus Computer
1303 46th St., Brooklyn, NY 11219, Phone: (800) 223-3411, (718) 436-4646

Global Electronics
3937 S. Sepulveda Blvd., Culver City, CA 90230, Phone: (800) 950-4487

Hard Drives International
1912 W. 4th St. Dept. HDU, Tempe, AZ 85281, Phone: (800) 767-DISK, (800) 733-0882

Hi Tech USA
1562 Centre Point Dr., Milpitas, CA 95035, Phone: (800) 831-2888, (800) 831-2780

Hokkins Systemation, Inc.
131 East Brokaw Rd., San Jose, CA 95112, Phone: (800) 526-2328

Kenosha Computer
2133 91st St., Kenosha, WI 53140, Phone: (800) 255-2989, (414) 697-9595

Laser Press & Graphics
4888 Stamp Rd., Marlow Heights, MD 20748, Phone: (800) 628-4517

Loma
946 Loma Dr., Hermosa Beach, CA 90254, Phone: (800) 369-2846, (213) 798-2835

Lucky Computers
1701 Greenville Ave. #602, Richardson, TX 75081, Phone: (800) 966-5825, (214) 690-6110

Lyco Computer
PO Box 5068, Jersey Shore, PA 17740, Phone: (800) 233-8760, (717) 494-1030

Main Street Computer
1611 Northgate Blvd., Sarasota, FL 34234, Phone: (800) 456-6246, (813) 359-3343

MegaHaus Drives
1110 NASA Rd., 1, Ste. 306, Houston, TX 77058, Phone: (800) 426-0560, (713) 333-1910

Micro Sales
7715 NW 56 St., Miami, FL 33166, Phone: (800) 222-8324, (305) 599-9470

MicroLab
23976 Freeway Park Dr., Farmington Hills, MI 48335, Phone: (800) 677-7900, (313) 474-4711

MicroProfessionals
19261 Burnham, Ste. 100, Lansing, IL 60438, Phone: (800) 800-8300, (708) 339-8398

Microcomputer Concepts
15200 Transistor Lane, Huntington Beach, CA 92649, Phone: (800) 772-3914, (714) 898-3002

Microwarehouse
PO Box 3014, Lakewood, NJ 08701-3014, Phone: (800) 367-7080, (908) 370-0518

MidWest Computer Works
350 Lexington Dr., Buffalo Grove, IL 60089, Phone: (800) 669-5208, (708) 459-6883

MidWest MicroPeripherals
6910 US Rte. 36 East, Fletcher, OH 45326, Phone: (800) 423-8215, (513) 368-2650

Mile Hi Micro
10525 East 40th Ave. #203, Denver, CO 8239, Phone: (800) 800-9828, (303) 375-1440

Minuteman Computers
887 19th St., Unit C, Costa Mesa, CA 92627, Phone: (800) 688-6468, (714) 646-9814

Myoda Inc.
1053 Shore Rd., Naperville, IL 60563, Phone: (800) 676-9632, (708) 369-5199

One Stop Micro
14126 Sherman Way, #345, Van Nuys, CA 91401, Phone: (800) 876-1786, (818) 782-6691

PC Connection
6 Mill St., Marlow, NH 03456, Phone: (800) 243-8088, (603) 446-7721

PC Zone
18005 NE 68th St., Ste., A110, Redmond, WA 98052, Phone: (800) 252-0286, (206) 883-3088

Paradise
PO Box 890553, Dallas, TX 75389-0553, Phone: (800) 348-4727

Publisher's Toolbox
6606 Carlsbad Dr., Madison, Wi 53705, Phone: (800) 233-3898

Publishing Perfection
PO Box 307, Menomonee Falls, WI 53051, Phone: (800) 782-5974, (414) 255-7600

Quick ELectronics
10800 76th Court N., Largo, FL 34647, Phone: (800) 800-5500, (813) 546-9299

Shecom Computers
22755 Savi Ranch Pkwy., #G, Yorba Linda, CA 92687, Phone: (800) 366-4433, (800) 872-6677

Soft Comp USA
3701 Harbor Blvd., Ste. 211F, Santa Ana, CA 92704, Phone: (800) 922-3544, (714) 957-3325

Software Add-Ons
3331 Street Rd., Ste., 155, Bensalem, PA 19020, Phone: (800) 822-8088, (215) 639-7110

Software Unlimited
2465 W. 12th St., Ste. 5, Tempe, AZ 85281, Phone: (800) 926-7638

Star Ware
3174 Sunset Ave., Norristown, PA 19403, Phone: (800) 523-0702, (215) 584-8770

Storage Devices, Inc.
PO Box 58234, Webster, TX 77598, Phone: (800) 835-3023

Sunnytech
500 Hollister Rd., Teterboro, NJ 07608, Phone: (800) 367-1132

Syntax
18535 E. Gale Ave., Industry, CA 91748, Phone: (800) 552-8900, (818) 854-6363

Telemart
8804 N. 23rd St., Phoenix, AZ 85021, Phone: (800) 537-4735

Treasure Chest
1310 Carrol St., Kenner, LA 70062, Phone: (800) 245-3040, (504) 468-2113

TriState Computer
160 Broadway, New York, NY 10038, Phone: (800) 433-5199, (212) 349-3134

US Turbo Systems & Computers
1819 N. Floradale Ave., South El Monte, CA 91733, Phone: (818) 579-2405

Verticom Corp.
2810 NW 72nd Ave., Miami, FL 33122, Phone: (800) 345-4891, (305) 592-9246

Warehouse 54
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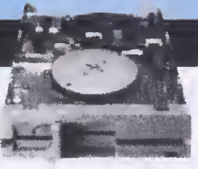

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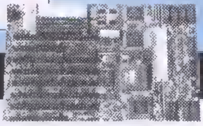

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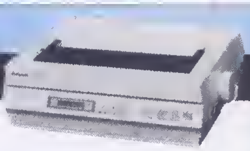

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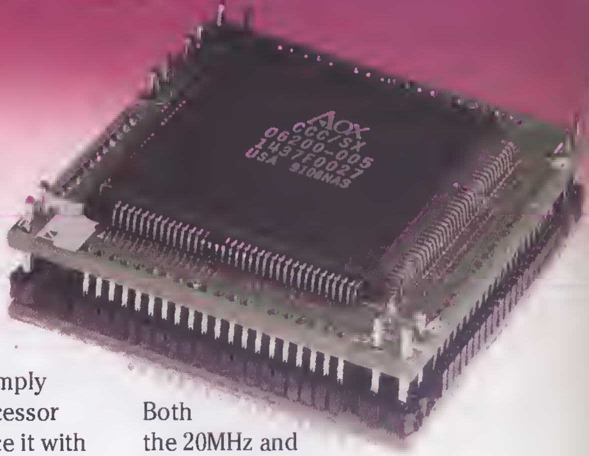

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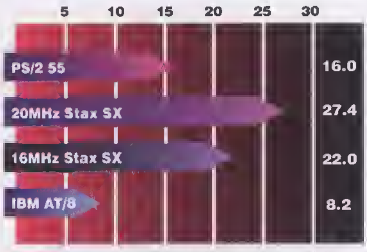

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